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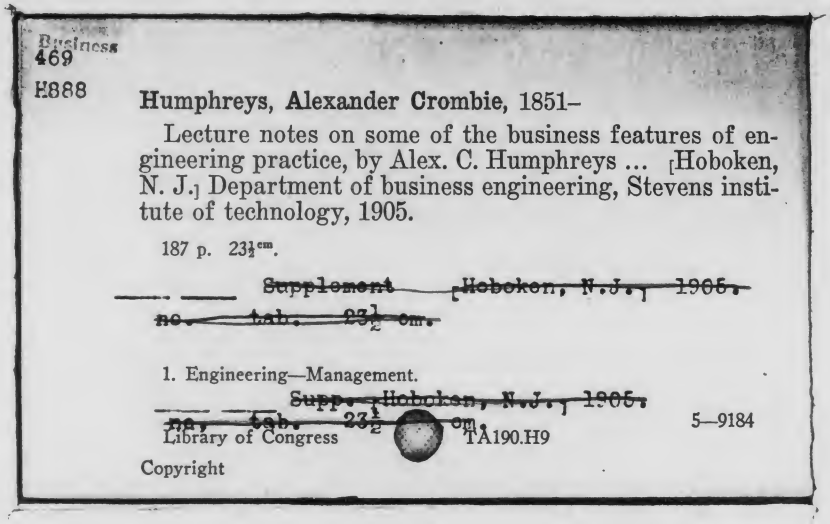

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Lecture Notes
ON SOME OF THE
BUSINESS FEATURES
OF
ENGINEERING PRACTICE

DEPARTMENT
OF BUSINESS
ENGINEERING
Stevens Institute
of Technology
1905

LECTURE NOTES

ON SOME OF THE

Business Features

OF

Engineering Practice

BY

ALEX. C. HUMPHREYS, M. E., Sc. D., LL. D.

President of the Stevens Institute of Technology

DEPARTMENT OF BUSINESS ENGINEERING

Stevens Institute of Technology

1905

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INTRODUCTION.

In this department the students are first required to read the "Reprints of Lectures and Papers" which were gathered together for the purpose of cultivating in them a more sympathetic attitude of mind towards the specific instruction which is in part covered in these lecture notes.

In writing these notes and in putting them together I have made no attempt to avoid repetition, but my aim has been rather to consider the same proposition from several points of view in the hope that I might so better remove the difficulties that have developed in the work of the class-room.

Experience with three senior classes has convinced me that this repeating and paraphrasing is required to enable me to give inexperienced students a firm grasp of the essentials included in my course, unable as I am, by reason of insufficient time, to afford them the advantages of extended practice in examples.

The actual repetition is far greater than is here indicated, for, in my lectures as delivered, I give many additional examples from my own experiences, selected to meet the difficulties of the students as these difficulties become apparent.

I do not hesitate to include commonplaces. My hope is that especially where these have to do with the ethics of our noble profession the members of my classes will, through a cultivated receptivity, come to accept these commonplaces as active and controlling truths.

These pages are placed in the hands of the students so that they need not be obliged to rely solely upon my spoken words, but may have something to study outside of the class-room in preparation for examinations.

Notwithstanding the fact that I have not been able so far to cover by written notes all of the matter included in my course, I feel that the students should be able to prepare on all I present because much that is most difficult to comprehend is here given

in permanent form and the remainder I give them full opportunity to discuss with me in class.

The notes on the Law of Contracts were prepared at my request by my friend and counsel, Howard E. White, Esq., of the New York Bar, to whom I wish now to repeat my grateful acknowledgments.

The commencement address to the Class of 1904, delivered by Walter C. Kerr, Esq., would have been included more appropriately in the "Reprints of Lectures and Papers," but as this was not feasible I have reprinted it here that Mr. Kerr's sound advice, so admirably presented, may be preserved for future classes.

I hope that I may be able to develop from these and supplementary notes a text book on the business features of engineering practice, based upon my experiences in the fields of Engineering and Business as to the matter, and upon my experiences in the classroom as to the most efficient methods to be employed in presenting this matter to engineer-students already pressed for time in which to perform their assigned tasks.

ALEX. C. HUMPHREYS.

THE STEVENS INSTITUTE OF TECHNOLOGY,
HOBOKEN, N. J.

THE POINT OF VIEW.

(Address to the graduating class delivered by Walter C. Kerr, Esq., at commencement exercises of Stevens Institute of Technology, June 16, 1904.)

It is a pleasure to talk to a lot of young men who are about to become engineers. It was not so long ago that I came to your age less well prepared, perhaps, than any of you. When I look back at the engineering education through which men of my time were launched, and then consider the training you have had and the opportunities before you, I have reason to wonder why I am here.

I hesitate to advise you. You have already had so much advice that I do not know whether you can hold more. What I can say in a few minutes will amount to little, so let me use these minutes to suggest that you advise yourselves along certain lines which I will propose by way of point of view. If you look straight you will see straight. You cannot think wrong and act right. Your perspective will be distorted if you haven't the right point of view.

You are leaving a good institution for a good world. Your Alma Mater has built up around you excellent facilities for giving you what you need, and other institutions have likewise cared for their own.

The so-called liberal education has always been highly academic. Trade school engineering has been strictly non-academic. The two have joined hands fortuitously in our modern institutions. The liberal education has become less and the technical more academic, with advantage to both. There is, however, danger of engineering education growing too academic, for several reasons: One is the disposition to include in technical training a liberal education, which of itself is not undesirable. Another is that engineering professors often lean unduly towards academic views and processes, and thus lose touch with the spirit of the

engineering world. Greater than either of these is the tendency of all things to move in the line of least resistance, and all learning which depends upon the intellect alone is more easily acquired than that which depends upon other sources. The proof of this need go no further than to remember that no literature is finer than that written two thousand years ago; no philosophy has fundamentally improved upon that of the ancients; the highest flights of intellect and mathematics were reached during the ages in which the world was observed to be composed of four elements —earth, air, fire, and water.

A review of knowledge shows the great preponderance of the intellectual over the material, and it is only within late centuries, in fact almost the past century, that the human mind has seemed capable of turning from the lesser resistance of intellectual attainment to the greater capacity for physical observation and comprehension. We have but recently come to the era of intense mental operations, dealing with laws and principles which require insight greater than the intellect can grasp unless aided by the senses. Contrary, therefore, to common belief, I assert that the highest refinement of knowledge follows from the highest use of the senses; and that it has taken thousands of years of pure intellectual development to attain a state in which the powers of nature can, through the human intellect, be made useful to mankind, and add largely to knowledge. Do not, therefore, get a wrong view of the faculties involved in science, in the application of the laws of nature, applied mechanics, and the powers of comprehension which underlie engineering. There is still room for doubt —not debatable here—as to what constitutes liberal education.

I hope for the time when the spirit of engineering as found in practice will form a more definite part of engineering education. This, I think, must come through the professor keeping in close practical touch with the engineering world. There are various ways in which this may be accomplished, but I know of none better than by each professor doing a reasonable amount of practical work for commercial purposes. Under some conditions, this may be consistently accomplished during a portion of the time, but I am inclined to think that eventually our professors will devote all their time to instruction while they teach and go periodically into the world, a few years at a time, for practice. Thus the professorial life would not be so exclusively educational, and our growing engineering institutions may be enabled to enlarge their faculties by the devotion to teaching of a portion of the time of men who are primarily engaged in commercial work.

Now that you have your so-called education, what are you going to do with it? I cannot tell you, but I can suggest some points of view.

Begin by forgetting yourself. All thought of self is some form of selfishness, and selfishness never produced anything better than more selfishness. It often breeds something worse. Genius is all right in its way, but it will not do your work. Get a right idea of work. Remember that time is the essence of most things, and is not inconsistent with thoroughness.

We hear much about opportunities. They are everywhere plentiful. Remember that your opportunity is the little one that lies squarely in front of you, not the large one which you hope to find further along. Many a man is surrounded with opportunities who never seizes one. There are traditions that Adam, William Tell, and Sir Isaac Newton each had an affair with an apple, but with different results.

Your first duty is always to that which lies across your path. The only step which you can take in advance is the next one. This leads to a simplicity of action which is commendable. Don't ramble.

The refinement of thought which is apt to follow high training often leads the mind to overlook simplicity and to even seek complexity. The wealth of modern appliances tends likewise; and it is thus easy to acquire that over-refinement, often termed theoretical, as against the simplicity which is called practical.

From one point of view all gradutes can be divided into two classes: those who think their knowledge is a little long for their opportunities; and, those who think most anything is a little long for their knowledge. Both are apt to think that the knowledge they have acquired will become the essence of performance. You will soon find that knowledge hasn't much to do with effective-

ness. It is necessary, only as words are essential to the expression of thought. You will find knowledge a good tool, but not the vital force with which you perform. You will fall back upon human effort and action, and find that it is the human-engine and not the knowledge-engine that does the work.

Cultivate singleness of purpose. This is more important than you may think. It is intuitive with the comparatively ignorant, and often absent in the highly trained. We are frequently surprised at the great competency of the ignorant contractor or foreman, on whom judgment is often passed by saying that he is a practical man and gets results. Analysis will show that his best quality is singleness of purpose, which leads him to vigorously do the one thing before him, without distraction following from knowing or thinking about too many other things. The broadening power of education and training increases the range of contemplation, but unless the power of concentration is cultivated there follows a tendency to scatter instead of to acquire that singleness of purpose which leads to effective action. David Starr Jordan has said: "The purpose of knowledge is action. But to refuse action is to secure time for the acquisition of more knowledge. It is written in the very structure of the brain that each impression of the senses must bring with it the impulse to act. To resist this impulse is to destroy it. * * * This lack of balance between knowledge and achievement is the main element in a form of ineffectiveness which, with various others, has been uncritically called degeneration." Thus President Jordan shows how even much more than a little knowledge may be a dangerous thing. The highly-trained man therefore needs, as a complement to his training, unusual powers of concentration, in order that the virtue of singleness of purpose may not be lost. This faculty a man must have or acquire himself. It is not in the books. It cannot be taught. It can only be suggested by precept and example.

From directness of purpose naturally follows diligence in getting what you go after, and not being easily turned aside by resistance. When you are getting what you go after, get it all. Avoid the mediocrity of compromise. Be thorough and stand

for full competency in everything, from main essentials to details. Just so far as education, assisted by concentration, contributes to singleness of purpose it is useful, but where by length, breadth or depth it dilutes human effort, it lacks value. It is, therefore, not so much the question how much educational training you have as it is how you use it. Some can use a little with great effect, because their point of view is right; others scatter so badly that they cannot use their knowledge at all; while some distorted minds seem to have a faculty for misapplying a large amount of acquired knowledge through complicated processes full of error. To be right, you must be 100 per cent. right. Charity may pardon human nature its percentage of delinquency, but this is a human matter. The laws of nature, mathematics, and engineering do not pardon anything. The man may therefore be absolved from censure, but his work must stand the rigid test of inviolable law. Nor is it too much to say that you must be right the first time. Much of our engineering is only done once, and it must be done right that once. A man who has learned by experience to do a thing deserves no credit for doing it right. He is then only a repeating machine. Real power is characterized by ability to perform right the first time that which a man never did before. Such performance involves the power to assimilate and adapt experiences, of more or less like or unlike kind, in a way to bring forth correct results. This is the true use of experience, wherein a man is a thinking, active power, and not a mere repeater.

Clearness of thought is an essential often lacking. This, too, follows from concentration and singleness of purpose. Many minds confuse themselves with a wealth of ideas, grading from the well formed to hazy, indistinct conceptions. You can clear your mind by proper habits of thought. Train yourself to separate essentials and non-essentials and confine your consideration to the essentials; to distinguish between what you know and what you only vaguely surmise, clearly eliminating opinion from facts. Nothing is more helpful than conference with yourself, in which you determine what you think of your own thoughts. This is aided by the moderate cultivation of system—thinking in an orderly manner, beginning at the beginning, ending at the end,

and being sure to have a middle. With this there should be no slavery to system, but let each find his own logical way.

Besides what are commonly known as ideas, men have intuitions—sometimes called impressions or opinions—which they cannot readily prove. These I believe are identical with reason, except that while reason is composed of a sequence of distinct ideas, each capable of expression, intuitions follow from the capacity of the human mind to integrate small ideas and impressions, each of which is too small to stand alone, or to be readily expressed, but which integrated form a concrete mental impression, called an intuition, and which is of exactly the same character as reason, except that it is composed of smaller and almost intangible units. Do not, therefore, discard intuitions as inferior to reason. Analysis will sometimes develop intuition into an expressible logical thought.

You have all had ideas and you will have more of them. Some ideas seem bigger than others. These mental forces, like other forces, only do work when in motion. Hence your ideas are only valuable when put into execution, and this often requires more talent than to originate them. Some men seem to consider their ideas so good that they will execute themselves.

A point of view is involved in the power to rationalize. This again is a thing which each man does for himself in his own best way, and its essence consists in asking one's self whether the thing is reasonable. It is a great check upon error. It applies equally to nearly everything of which engineering is composed. It is the power of the human mind, after performing in more or less systematic and conventional ways, to stand off and look at results and ask one's self whether they are reasonable. One man will figure that certain material weighs two hundred tons, and believe it. Another will say that there is something wrong in that, for it all came on two cars.

Every young man comes sooner or later upon a dilemma, in which he is more or less drawn in opposite directions by his confidence on the one hand and timidity on the other; a desire to perform backed by the courage of his convictions, but on the other hand resisted by his inability to see his way through in

orderly progression to a desired end. This is about the time to show your nerve. Don't be dazed and baffled, but make a start. Use your wits and you will get somewhere, and if you cannot always see the end it will constantly get nearer and plainer when you go as far as you can see and then see how far you can go.

Another point of view concerns engineering expression. This may be through designs, drawings, mathematical determinations, or words, and finally by work done. The lamest of these is words. All engineering is so non-literary in character that the use of language is too much neglected, leading to expressions that do not properly convey thought. In engineering, it is not rhetoric but diction that makes expression clear, and diction is best learned from the dictionary. It is well for a young engineer to cultivate his vocabulary, and learn to use words in their right sense. They are then usually understood, even by those who have less knowledge. A word of caution, however, against assuming that a lack of facility of expression can cloak an absence of knowing what you think. Engineering documents, specifications and letters are full of mis-statements due to the careless use of language. Conciseness cannot be over-estimated. Brevity is desirable, but not at the expense of clearness. Conversely, a certain degree of facility should be acquired in reading the words of others. Some seem incapable of understanding plain language when spoken or written. Anyone persistently failing to understand the language of others has limitations needing correction.

One of the worst attributes in engineering, and which is fundamentally born of conceit, tends to fasten error, censure, and responsibility on others. There are times when a man needs to stand himself up in front of himself and ask: What is the matter with me? The capacity of any man to admit his own error and frailty of judgment is a measure of strength rather than weakness.

Perhaps no personal attributes are of greater importance in the conduct of the business affairs of an engineering life than good cheer and non-contentiousness. Not only because these

are right and agreeable, but because they enable a man to work better, to be better understood, and they add weight to his opinions. There is a certain reasonable optimism of manner which makes a man and his ideas welcome, even though they must of necessity sometimes be critical. To vote aye and believe that things can be done makes a man helpful to others and to enterprises. Discontent is not a sign of progression.

Each of you probably has a preconceived notion of following some line of engineering. Be careful about your self-analysis. The field is large and has room for all of the various types of men, some of whom incline to constructive operations, others toward inventive, some to the contemplative. Again, within all these divisions, some tend towards professional and others trade work. No one can advise what is best for you. This you must find out for yourself. I cannot help, however, a certain predilection in favor of a young man being just an engineer, and not any particular kind of an engineer—not specializing while too young, but developing along versatile lines, ready to turn his hand equally well to any task within his general scope. In this, there is a good deal in the point of view, and the man who believes he can apply himself in one direction about as well as another will come nearer doing it than one who thinks he cannot.

When you start your practical work, you will doubtless try to improve things. That is a legitimate purpose, if not overworked. I am not going to attempt to tell you what needs improvement, but the one improvement that most things need is in the line of sufficiency. You can think this over for yourself and apply it where it fits.

There is another point of view seldom considered. It relates to environment and the power to vary. It is pertinent to engineering. Man ascended through and exists under the laws of an organic evolution, which occurred almost entirely in early geological ages, under water, within a few miles of shore, under substantially constant temperature, constant pressure, and uniform food supply, and thus in about the simplest possible environment. It was caused, primarily, through the force known as the power to vary, and the reason that evolution spanned the

space from the simple cell to the vertebrate animal in so short a time was that this power was not resisted by complex environment. When organisms emerged from the water to the more complex environment of the land, and as environment grew constantly more intricate, its resistance retarded evolution and resulted in fixation of species until ordinal evolution practically ceased. It is the complexity of the environment of the world that presses upon you and tries to hold you back from the exercise of your native power to vary. A good environment is certainly less harmfully resistant than a bad one, but remember that environment is not a force. It is not a producer. You are the producer. Whatever be your power to vary, environment will only resist and reduce it.

Therefore, remember that all the good you accomplish is going to come out of yourself. You cannot borrow it and you cannot make it out of that which has been poured into you by education or otherwise. All that you receive is only a certain quantity of knowledge, acquired by education, experience, or other training, which will have a certain influence upon what comes out of yourself as your own. It is the inherent capacity to perform with your own brain which will make you what you become, and not the mere transmission of that which you have acquired. Your knowedge, therefore, is of little avail until you make it inherently a part of yourself through mental assimilation and utilization. The clearer you comprehend these things, the more readily you can make use of them as against the process of mere acquirement with a vague motive that in some way or other what you acquire may be of benefit, or that environment will be the force that makes your talent effective. Some have gone through experience without acquiring it, and many a man who has received an education has not got any because he allowed it to be a thing apart from his personality and it slipped away.

NOTES ON CONTRACTS,

(Prepared by Howard E. White, Esq.)

Law is concerned with the exposition and application of those principles which regulate the relations of man to man. Criminal law prescribes and enforces the duties which man owes to the State and to the public as a whole.

Civil Law deals with the private relations of individuals between themselves, and finds its chief end in preventing the occurrence of differences in the manifold activities of civilized life, or of adjusting such differences as shall have arisen. Law, in its broadest sense, is based upon a very few elementary principles of justice, fairness and equity, which may be as well and easily understood by the layman as the lawyer. The technical niceties and refinements of the law have to do with the application of these principles to concrete cases, and require a lifetime of unremitting research and study. They are the special province of the lawyer.

No layman, however talented, is qualified to master these legal intricacies, but no one, however small his business, can fail of benefit from a consideration of general legal principles. The more widely they are understood and heeded in carrying on the everyday affairs of life, the less chance there will be of entanglement in tedious and expensive litigation, which may, whatever its outcome, ultimately ruin the most prosperous business or cloud the success of the most talented individual.

It is a matter of common experience to see men, eminent in their own specialties, so ignorant of business and its methods as to fail of success when they attempt to practically apply their knowledge and talents.

The object of these notes is not to attempt to impart knowledge which will enable a layman to become his own lawyer, but

rather to instill a knowledge of the legal necessities of business life, and to make possible the formation of a correct judgment as to when legal aid should be retained.

Money wisely spent for competent legal assistance, when large projects are in their inception, is likely to save the expenditure of a much larger sum in an attempt to correct the disastrous result of a careless or improvident act.

The Law of Contracts Important to Business Men.

A generally accepted classification divides the body of legal principle into two parts:

1. Those which concern Torts.

A Tort is the violation of some legal duty owed by one individual to another and existing independently of any contract.

2. Those which relate to Contracts.

While some lawyers make a specialty of the former class, in which are comprised suits to recover damages for personal injuries, by far the larger number of attorneys are concerned almost exclusively with the second branch of the law.

Varied as the activities of modern civilization have become, it still remains true that, broadly speaking, the life of the average business or professional man is for the most part concerned with making and performing contracts. In the last analysis almost every action of the day brings us within the reach of some contract, express or implied.

Some knowledge of contract law, therefore, is a fundamental necessity to everyone.

What Is a Contract?

This seems a simple question and one to which almost every layman feels competent to respond. An attempt to do so, however, shows how difficult it really is to frame a definition sufficiently broad to cover the multitudinous varieties of contracts which are legally possible.

Almost as many definitions have been given as there are contracts. A sufficiently simple and non-technical one is as follows:

An agreement, enforceable at law, creating an obligation not

theretofore existing, upon the parties or some of them, to do or refrain from doing some lawful act, in return for value received.

The most important feature of a contract is, of course, that it is the basis of some *new* agreement. It is creative, and by it the parties voluntarily assume obligations from which they were formerly free. The importance of a contract, from the standpoint of law, arises from the fact that, whereas it is created by the voluntary act of the parties, once made, it will be enforced by the courts, as strictly as though its terms were a part of the statute law of the State. The very freedom given by the law in respect of contracts imposes upon the contracting parties the necessity for an added measure of caution. The Courts extend no protection to the maker of an improvided contract. When it has once been signed the obligations imposed by it are as binding as though its terms were of the most advantageous character. The law supposes that in making contracts the parties themselves are best qualified to fix its terms, and, though these may at a subsequent date prove oppressive, the law will extend its utmost aid to their enforcement. The inviolability of contract rights is most jealously guarded by the law. The Courts are called upon to consider more cases arising out of contracts, than from any other source. Out of the infinite variety of private agreements entered into arise an infinite number of variations in the application of established principles. To cope successfully with the niceties of interpretation the lawyer must be possessed of acumen, perseverance and genius. This is the technical side of law.

Executed and Executory Contracts.

Contracts are divided as respects the time of performance into two major classes.

1. Executed.
2. Executory.

In the first class are included those contracts which are performed, substantially at the time when they are made, or so shortly after as to make the whole transaction simultaneous, as in the case of a purchase of merchandise followed by immediate delivery. The agreement as to price constitutes a contract, which

is immediately executed or performed as the buyer departs bearing his purchase.

An *executory* contract is one in which a substantial lapse of time occurs between the making of a contract and the carrying out of its terms.

It is to the *executory* contract that we usually refer when we popularly speak of a contract, and it is with that branch of contract law that the present notes are concerned.

A large number of the contracts entered into are performed without differences between the parties. But it is certain that no contract should be made in any spirit of fancied security arising from this fact. The best of friends and the closest business associates are prone to disagree, and the better the friendship and the closer the association, the severer the breach. Every contract, therefore, which involves future performance should be regarded with respect to its ability to stand the test of such a disagreement and its consequent construction by the courts. It is obvious that the more distant the time of full performance the more chance there is for misunderstanding and difference.

Express and Implied Contracts.

It is important to remember that not all contracts are reduced to writing, or even orally phrased. It sometimes happens that a man by his acts, perhaps unintentionally, involves himself in certain obligations which he little suspects. This fact gives rise to another subdivision of executory contracts into

1. Implied Contracts.
2. Express Contracts.

1. An implied contract is a relationship, which springs unbidden from the surrounding circumstances. Certain civil acts a man cannot commit unless he would accept the consequences. Thus, if a merchant delivers goods to a prospective customer, without order, and the recipient retains and makes use of such goods, the law implies a promise or contract to pay for them. Possibly the customer was ignorant of the law, and never intended to pay for what he used, but he may be forced to do so.

This is the simplest example of an implied contract, but it often happens that very complex problems are presented when the question arises as to whether an individual has not made himself liable to certain obligations by a course of dealings which he never intended should have such a result.

An implied contract is a pitfall to the unwary, and is referred to here by way of warning. Luckily there is a plain danger sign posted at its margin, obedience to which will prevent danger. It lies in the business maxim: *"Do not expect to get something for nothing."*

It may sometimes happen that this law may be violated and the offender escape scot-free, but its disregard always raises the danger that having received benefits under the impression that they need never be paid for, the law will step in and insist upon a just compensation.

It is always safest to ask, when in receipt of obvious benefits: What do I give in return? Not only is this true in respect to financial matters, but as well in matters of favor. One who grants a favor will some day expect one, and generally two, in return.

2. Opposed to the implied agreement is the *Express Contract,* with which we shall chiefly deal.

An Express Contract is one, as its name implies, which is framed either orally or in writing, with the intent by the parties to enter into a valid binding agreement.

Examples are so common as to need no especial mention.

WRITTEN AND ORAL CONTRACTS.

Except in instances especially covered by statutory enactment, a verbal or oral contract is exactly as binding as one in writing, if its terms be sufficiently proved. The attempt to do so is often involved in insurmountable difficulty. For this reason, if for no other, the question of oral contracts may be briefly dismissed with the statement that *they should never be entered into if they can possibly be avoided.* They are always dangerous and give rise to more litigation and discussion than can well be measured.

Insist that every agreement made should be reduced to writing, if only in the form of a memorandum. In this way only can trouble be avoided.

STATUTE OF FRAUDS.

Some contracts must by statute be in writing in order to be valid. Thus, in every jurisdiction will be found statutes known as the Statutes of Fraud, which are practically uniform everywhere, and are to the effect that all contracts for the sale of property in excess of a specified amount in value; contracts which are not to be performed within a limited time, and contracts to become responsible for the actions of another person, must be in writing and signed by the person to be charged. The reason for such a statute is obvious.

Before passing to a consideration of the essentials of a contract, a word is proper as to the expression of its terms.

Many words do not mean a good contract. Still less does an excess of legal terms or phraseology. The best contract is the simplest both in form and language. As in every other written instrument, brevity should be sought, though not at the expense of clearness of expression. If, therefore, a contract is presented for signature, the meaning of which is not absolutely clear, signature to it should be refused. The word of an associate, or even of an attorney, that a certain unintelligible phrase has a definite meaning, is insufficient. If it be found that there is room for a discussion as to the meaning of a word, it should be remodeled at all hazards until there can be no two opinions as to the intent. The habit of careless expression leads to more ambiguity in contracts than any other one cause, and it is absolutely without excuse. The layman falls into the error through carelessness or inadvertence. At times the lawyer is equally negligent, but it also frequently happens that a lawyer attempts to draw a document so artistic in its brevity and conciseness that he sacrifices, more or less completely, clearness and common sense. But on the other hand one should not be misled into thinking that the best lawyer is one who draws the most elaborate or impressive contract. The reverse is apt to be the case. When one receives from an attorney a contract which appears to be so simple that it seems that it

might well have been drawn without legal assistance, it is certain competent counsel has been retained.

The foregoing statements have been, for the most part, explanatory and analytical. We now pass to the essentials of a contract, written or oral.

ESSENTIALS OF A CONTRACT.

1. Parties capable of contracting.
2. A lawful subject matter.
3. A definite, clear offer.
4. An unequivocal acceptance.
5. Complete agreement of parties.
6. Valid consideration.

1. Parties capable of contracting.

Every person who has attained legal age; who is under no civil or mental disability, temporary or permanent, and is free from compulsion, is capable of entering into a valid, binding contract.

In explanation of the foregoing the following should be noted:

Person.—The word person includes corporations and women. Corporations, however, must act within the scope of their charter powers. At common law married women were deemed incapable of contracting, but by statute in practically every jurisdiction this disability has been removed, and they may contract with entire freedom.

Legal Age.—By practically universal enactment the period of infancy terminates, for both man and woman, at twenty-one years. In some few jurisdictions women are deemed of age at eighteen. Local statutes should be consulted upon the point.

A contract made by an infant is not absolutely void, but may be avoided by the infant, who cannot, against his will, be forced to perform it. There are only two exceptions to this rule: One is that an infant may be compelled to pay for necessities furnished for maintenance or support. The other is that infancy is not a ground for breaking the marriage contract. It must be remembered, however, that if the infant be willing to

abide by the terms of his contract he can enforce performance from the other party thereto. In other words the defense of infancy is only available to the infant himself. A contract made with an infant during his minority may, however, ripen into a valid and binding contract when the infant becomes of age, provided, either expressly or by implication from his actions, he ratifies it after that time. Thus, if an infant makes a contract, and after becoming of age accepts benefits under it, it will make the contract a good one. The infant is under obligations if he wish to disaffirm his contract to do so within a reasonable time after he becomes of age. If he fail to take such action it is an implied ratification of his prior contract.

If the infant elects to rescind his contract he must, *so far as possible,* return all benefits which he has received thereunder. Should he fail to do so, he cannot escape liability upon his agreement. The general view, however, is that the infant is not precluded from rescinding his contract when he becomes of age by reason of the fact that it is physically impossible for him to return benefits thereunder. It sometimes happens that a contract has been partially performed during infancy, and that the minor has received some advantage therefrom. He may have received a sum of money for a piece of property sold by him, and have spent it before becoming of age. He may, nevertheless, recover the property from his vendee.

At first glance this appears to be a hardship, and it is a doctrine whch is frequently criticised by laymen. It is founded, however, upon the very reasonable idea that one who deals with an infant, does so at his peril, a minor being in the eye of the law, not competent to protect his own interests. The law takes care of this anomalous situation by allowing the appointment of a guardian for an infant, and through such guardian the infant may make all contracts which are necessary for his best interests.

Civil Disability.—In England and many of the United States, criminals convicted of felony, are debarred from exercising civil privileges. Imprisonment for life is accounted civil death.

Mental Disability.—Mental disability may be either partial

or total, permanent or temporary, and arise from permanent or acute causes.

One whose mind is clouded to such an extent as not to understand the nature of the act, is deemed incompetent to contract, whether such condition proceeds from insanity, intoxication or the use of drugs, and such contract is avoidable at the option of the person so incapacitated. While the rule, like some others stated herein, is occasionally modified in some jurisdictions, the prevailing rule in the United States has been given.

Compulsion.—A contract cannot be enforced against a person who is induced to enter into it by threats of personal injury to self or family, or of illegal detention or injury to property.

The foregoing considerations are somewhat technical; but they have been stated as simply as possible. For practical purposes, the most important points to remember, are the disability of infants and the limitation of the power of corporations. No important contract should ever be made with a corporation without legal assistance to discover first, whether the corporation has power to make the agreement, and second, whether such contract has been duly authorized by the directors, and authority delegated to the officer who attempts to bind the company.

2. Lawful subject matter.

It is the policy of the law to allow the utmost freedom of contract, and no limitation is placed upon the right to contract save only that a contract may not be made to do an act which is forbidden by law, or one which is opposed to public policy. Thus, one cannot contract to erect a building in violation of the building law, nor to commit a felony or a misdemeanor. It is usually simple to determine whether the object which it is desired to effect is forbidden by law. It is not always easy to determine whether the object is contrary to public policy. Cases frequently arise which appear to be innocent upon their face, and which to the lay mind seem to have no bearing upon any individuals other than the parties to the contract themselves. Upon a closer inspection, however, it is seen that they affect the underlying principles upon which is based our system of government. Thus, it is the policy of the law that every man should be free

to earn a living as he will; that trade should not be unduly hampered or constricted; that gambling should not be encouraged, that necessities should not be monopolized or the price thereof unduly inflated. An agreement to do any of these acts is regarded in the light of a conspiracy and will not be enforced by the court. In many cases one who is not a party to the contract may prevent the carrying out of its provisions, if harmed thereby. It will often be found that this question of public policy will confront those who are considering contracts to restrict the use of patented articles, or to limit the area within which parties to the contract may practice their profession. These questions are always troublesome.

3. Definite Offer.

All contracts are based upon an offer by one of the parties and an acceptance by the other. These are the preliminary steps, and present a variety of interesting questions. Thus, one offers to work for another and the contract is concluded by the acceptance of the proffered services.

The offer must be definite and, generally speaking, to a definite person. A vague offer makes either no contract at all, or at most, a very unsatisfactory one. In the interest of definiteness and clearness as a preliminary to a contract, the following warning may seem to be timely: A neglect to consider it is at the bottom of a large percentage of the difficulties arising out of contracts. One who proposes to make a contract must come to a clear understanding with himself in respect of what he really desires to accomplish. If he has a hazy, indistinct idea of the obligations which he is about to assume, or of those which he desires to impose upon others, he is almost certain to make an unsatisfactory contract, and end in litigation.

He must be careful not to confine himself to a consideration of present conditions. A contract of prolonged duration, which is acceptable to-day, may be objectionable next year, but will not be in any degree less binding; dissatisfaction is not a ground for cancelling a contract. He should not be content to take the opinion of those with whom he is contracting, as to what he desires, but will independently and carefully consider it from his

own point of view, and, having once come to a conclusion, will not be moved therefrom in essential points. Foresight is that quality which differentiates the successful from the unsuccessful man, and in making contracts no other quality is so much needed. A most frequent difficulty which is the subject of repeated comment by the courts in rendering their decisions, springs from the fact that one of the parties failed to give sufficient thought to the consequences of his agreements, or to anticipate conditions which a few moments' careful consideration would have made plain to him.

In stating that once having arrived at an opinion one should not be moved therefrom, it is not intended to counsel a spirit of uncompromising stubbornness, which would probably result in a failure to make a contract. Every agreement, when finally executed, usually contains concessions from the original propositions made by the parties, and one should be ready, after having determined what self-interest dictates, to make concessions at such points as are possible. But this should not be done lightly or unadvisedly. A concession made in a thoughtless moment and without due consideration, may mean years of litigation and financial loss. In making propositions or demands, however, it is essential to regard the interest of the other party to the contract. Fairness to others is one of the secrets of personal success. If, therefore, one approaches the making of a contract with an apparent unwillingness to regard any but self-interest, and an obvious desire to reap all the advantage possible without regard to the equities existing in favor of the other parties to the contract, though the negotiations may terminate in an agreement of some form, it will lack the surest guarantee of successful performance, mutual confidence and trust, without which the strongest contract may be turned into a bone of contention and the most promising prospects ruined.

Having definitely determined upon the offer, it must be communicated in any appropriate way, orally or in writing, by letter or telegram. In the interest of accuracy, however, the offer should, whenever possible, be reduced to writing.

The offer is a nullity until it is actually brought to the notice

of the person to whom it is made, and may be withdrawn at any time before it is accepted, notwithstanding a voluntary statement that it may remain open a definite time. Thus, an offer sent by letter may be withdrawn by telegram reaching its destination before the letter, or before acceptance.

4. Unqualified acceptance.

From the foregoing it is plain that acceptance should be prompt, if a contract is desired. Such acceptance must be of the exact terms of the offer. A counter proposition is not an acceptance and simply leads to further negotiations and a new offer. To constitute a contract, it must be possible for the one to whom the offer is made to say simply "I accept your offer."

Like the offer, the acceptance may be communicated in any convenient form, but unlike the offer, the acceptance becomes binding the instant it passes beyond the control of the accepting party.

Thus, the instant an acceptance is placed in the mail, or dispatched by telegraph, it becomes binding and the contract is complete possibly some time before the acceptance becomes known to the maker of the offer. Thereafter it is impossible for either party to withdraw from the contract unless by consent. This fact, it will be observed, often embarrasses one who makes an offer and wishes to withdraw it. Cautious business men heed the advice of Sir Frederick Pollock, who once said:

"The practical conclusion seems to be that every prudent man who makes an offer of any importance by letter, should expressly make it conditional on his *actual receipt* of an acceptance within some definite time."

5. Complete agreement.

Closely akin to the necessity of an explicit acceptance, is the rule that the minds of the parties to a contract must be in complete accord. This is known as the "Meeting of the minds of the parties," and no contract is complete without it. A contract, valid in all other respects, may subsequently be avoided or rescinded if it appear that the parties had not arrived at this meeting of the minds.

Such a situation arises when to all appearances the parties

have agreed, but in reality have never come to an understanding. The cases when this occurs are generally divided into the following classes:

a. Mistakes of fact.
b. Misrepresentation.
c. Fraud.
d. Undue influence.

a. Mistake of Fact.—It sometimes occurs that all the parties to a contract are misled as to the subject matter of their agreement. Thus, a cargo of grain was sold while in transit by sea to London. It subsequently appeared that prior to the sale the cargo had been destroyed. It was held that the sale was invalid. Similarly, where a contract was made to dig a thousand tons of potters' clay yearly from certain territory, and it subsequently transpired that at the time of making the contract, there was not so much as one thousand tons of clay under the land, the agreement was declared void. Again, A may agree to sell to B a horse (meaning a certain bay). B agrees to purchase the horse, supposing it to be another animal. No contract ensues. It is, of course, obvious that to avoid the contract, the mistake must be in respect to some vital, material point.

These mutual mistakes are comparatively rare and do not, ordinarily, cause great difficulty. Much more intricate are the questions involved in the following cases:

b. Misrepresentation.—It sometimes happens that one party, without evil intent, *unintentionally* misstates facts, or misleads the other party. This is known as misrepresentation, and must be carefully distinguished from fraud where the deception is intentional.

Where the misrepresentations occur in preliminary negotiations, they have no effect upon the validity of the contract, *unless* the relations between the contracting parties were such that they owed to one another some special duty of exact and explicit statements. Such is the case when the parties occupy a confidential relationship to one another, as that of principal and agent, attorney and client, and the like. Such a situation also arises where from force of circumstances one party must rely upon

the other for his knowledge of the facts. In this case the other is bound to the utmost good faith.

But it sometimes happens that instead of the innocent misrepresentations being preliminary to the contract, they actually become an integral part of it, and the inducing cause for making it. The representation then, amounts practically to a covenant or warranty, and if false, may be made the basis for a cancellation of the contract. A single instance will suffice:

A being about to sell a horse to B, *without any guarantee,* says "the horse is sound." B buys and finds a defect; he cannot rescind. But if A says "I warrant the horse sound," and a blemish appears, the transaction is a nullity.

The practical application of this doctrine to business men is that they should show extreme care in making hasty or thoughtless statements in entering into a contract. Let all information which is given be such as may be substantiated by proof, and let no guarantees be made which cannot be performed.

This leads, naturally, to a consideration of a kindred nature. The surest way to promote litigation over a contract, and to land in an endless maze of trouble and difficulty, is to have a party to a contract fail to appreciate the true significance of what he is doing. We have adverted to the necessity of a complete knowledge of one's own position. It is equally essential that all parties should appreciate their responsibilities. It is a matter of frequent occurrence to have a client request his attorney to so phrase certain portions of his contract so that he may create an obligation upon the other side which will not be suspected at the time the contract is made. Nothing is more foolish or short sighted, and no wise attorney will accede to such a request. The reasons are obvious. If the obligation is one which should in fairness be assumed, it should be stated openly and frankly. If, on the contrary, it is of such a nature that the contract would fail of consummation if it were expressed in the instrument, an unfair advantage is about to be taken, and when subsequent to the making of the contract its true meaning is disclosed, it will result in one of two things. It may be that the agreement will have been inserted in such a skillful manner that it can be enforced, in which

case the advantages gained therefrom will be at the expense of confidence and good will; or, as more frequently happens, the contracting parties will be involved in a lawsuit, which may extend to the third and fourth generation of their descendants.

c. Fraud.—*Fraud is willful misrepresentation or suppression of a material fact made by one party with intent to induce another party to enter into a binding agreement, and which has such a result.* Fraud is always a complete ground for the rescission of a contract, and no agreement can survive its taint.

Every word in the foregoing definition is essential, and the elements of fraud are carefully stated. It must be willful and intentional; calculated to work injury, and result in it.

Cases of willful affirmative deception are comparatively simple. Usually the only question is as to whether such deception relates to a material point.

A much more difficult problem arises when we consider the question of a suppression of material knowledge. What facts is one bound to reveal in order to avoid the taint of fraud?

On the one side is the danger of fraudulent suppression of fact; on the other is the quixotic impulse to disclose all that is known, including legitimate special knowledge or business secrets. Thus one may buy a house, knowing of impending developments which may enhance its value. No obligation exists to disclose such knowledge. But if a man sells to another stock, which from special knowledge he knows to be worthless, it is as obviously a fraud.

Unquestionably, the line is a fine one between the two cases. But consider that in the second instance the seller by accepting payment impliedly sold something of value, and the case is practically similar to one of willful misrepresentation. Here then is the test. When the suppression of facts amounts to a false representation that they do not exist, then the element of fraud is present.

But, after all, the best safeguard to business men against charges of misrepresentation or fraud is a high standard of business ethics, which makes one willing to forego profits which might be gained by sharp practice or doubtful methods.

While such distinctions as have been suggested above are sometimes difficult to phrase in words, no man, whatever his character, finds any trouble in practically determining whether his acts are such as conform to the generally accepted standard of moral duty. However far, personally, he may have departed from a high standard of personal rectitude, and however successful he may have become in stilling the voice of his conscience, that arbiter of duty never dies, and if questioned will, with the same certainty with which the magnetic needle points to the north, indicate conduct which would willingly be submitted for public approval, and that which would preferably be concealed from general knowledge.

Such words are not mere ethical theories, but point the way to the most practical test a business man can apply when in doubt about the legal aspect of a proposed course of action. Let the question be asked: "Would I be entirely willing to have such action generally known among my friends and business associates?" If the question can be honestly answered in the affirmative, no fear need be felt that the proposed course of dealing will ever be branded by the law as fraudulent or worthy of condemnation.

If the question be answered in the negative, it is certain that, while such method of business dealing may in any single instance add to pecuniary prosperity, it will in the long run mean loss of reputation and the confidence of the business community, as well as make extremely likely ultimate censure from the courts.

If error must be committed, let it be upon the side of overfairness to business associates rather than upon that of unscrupulous methods.

d. Undue Influence.

When an individual is so situated that the will has become subservient to another's to a point where independent action is practically impossible, such individual is said to be unduly influenced.

The most obvious example of such a condition is where one who is of feeble mental powers comes so under the power of a stronger personality as to yield unquestioning obedience. The

dependent person need not be of unsound mind (which would make him incapable of contracting) in order to justify the court in saying that agreements made by him under such influence, lack the essential element of a complete meeting of the minds.

Such cases most frequently arise in instances of persons of advanced age, or in unusually dependent circumstances.

A contract entered into between such a person and the one who is in a position to unduly influence the judgment, by which the latter benefits, is always scrutinized minutely, and is more than likely to be set aside.

Sometimes this undue influence arises from the possession of a real or apparent authority, sometimes from the necessity or distress of the injured party. The result is the same.

When one who is to be benefited thereby, enters into a contract with another who is dependent upon him either for advice or assistance, it should be insisted that the contract be submitted to some disinterested person before execution. In this way will be avoided serious complications and charges of bad faith which may be as painful as they are untrue.

Duress, to which reference has been previously made, is sometimes considered in the light of an obstacle to the complete meeting of the minds, but the writer prefers to treat it, as has been done, as a condition which incapacitates the party affected by it, from entering into a valid contract.

6. Valid Consideration.

While the law does not concern itself with the details of contracts made for legal purposes, and will enforce them according to their terms, there is one element which is essential to their validity. Some return must be given for every promise made or right surrendered. This return is the *consideration* for the contract. It must be present in every contract in some form or another. If absent, the contract cannot be enforced, for it is clear that if one promise to do something for another, and receive no benefit from so doing, he cannot be forced to fulfill his contract. A few examples of the plainer or simpler character will make this clear.

1. A man agrees to build a machine for another who agrees to pay a stated price therefor. The contract is a valid one and may be enforced. The consideration for the promise to build the machine is the promise to pay the agreed price, and *vice versa.*

2. A promises to build a machine for B, but B makes A no promise that he will either accept or pay for it. The contract is absolutely void and unenforceable. There is no consideration for A's promise.

These are simple forms and might, perhaps, have been given from general knowledge by any layman. All contracts, however, are not simple and it is often difficult, if not impossible, to determine whether a valid consideration has been given or not. Thus, it is not a valid consideration for one to agree to do what he is already under obligation to do. If A, therefore, promises to pay B a debt which is already due, it would not serve as a consideration for B's promise to build a machine, but, on the other hand, A might agree with B that if B would build the machine, A would, for a definite period, not compete with B in his business in a specified locality. This consideration would be sufficient.

To put it in its simplest form, therefore, if one desires to enforce a provision of a contract for his own benefit, he must make sure that he has given some value to the person with whom he is contracting, in return for the benefit he is to receive from him.

The first question, therefore, which a business man will ask himself when about to make a contract is, what will he give in return for that which he expects to receive? He must give something. What is given is not altogether material. The law will not pass upon the question as to whether *adequate* value is given for what is received further than to say that the relation between what is given and what is received must not be so disproportioned as to be palpably unfair or unjust. Thus, if one offers to sell a horse, and the buyer agrees to pay $50 therefor, it is a complete consideration, although the horse may really be worth $250. If, however, the buyer agrees to pay but $1, and the horse was shown to be worth $1,000, it would probably be

said that there was no consideration. It must be at once apparent that this is a fruitful subject for discussion in the courts, although the usual determination is that the court will not pass upon the adequacy of the consideration, so long as a consideration existed at all and is not unconscionably small.

The particular character of the consideration or value which is given for what is received, is not important. It may take a variety of forms. As has been previously stated, it may be the payment of a specified sum of money; it may be the performance of work or services; it may be an agreement to refrain from doing certain acts; it may be the suffering of some harm or detriment; it may be the foregoing of some legal right; but in the last analysis, something must have been given up, or the contract is unenforceable.

If a complicated contract is being negotiated, it may be that the real consideration which will support it is something totally different from the conception of the parties. It is the business of the attorney to see that this consideration exists, or is made to exist, and that it should appear in the contract. Many a valuable contract has been lost by reason of a failure to properly express the consideration. Let no one be deluded by the fact that a contract bears a seal, or that it contains the usual clause "in consideration of One Dollar." Both of these safeguards will prove broken reeds, if no true consideration exists.

Formalities Attending the Making of Contracts.

Mention has previously been made of the necessity of having contracts in writing. It was stated that it was not always necessary to have the written instrument of a very elaborate character. A few words in connection with the form of contracts may not be amiss.

Every contract should be signed by all the parties. A seal should be affixed for the purpose of raising the presumption that a consideration exists for the agreement. Originally, at common law, the seal was conclusive evidence of consideration, but the development of law has resulted in almost every jurisdiction in doing away wholly, or in part, with the distinction between

sealed and unsealed instruments. A seal has the added effect of prolonging the time within which actions to enforce the contract must be brought. Thus, in New York, an action on a contract *without* seal, must be brought within *six* years, while *twenty* years is given within which to sue upon a sealed instrument.

Contracts with corporations must always bear the seal of the company. It is the legal sign manual of the corporation.

The form of the seal is immaterial, and in most states a scroll, or the word "Seal" written by hand, is sufficient.

The question is frequently raised, whether it is necessary to have the signatures to a contract attested before a notary. If it is intended to have the instrument publicly recorded, it is in almost every jurisdiction necessary that it should be acknowledged. For instruments which are not to be so recorded, there is no absolute necessity either for an acknowledgment or for a witness. It is, however, desirable in every case to have a witness, if possible, and to have the paper acknowledged when it can be conveniently done. This springs from the fact that such a witness or acknowledgment facilitates the proof of the instrument. Every evidence of care in the signing of a contract adds to the force of its contents. In addition to this, the acknowledgment before a proper officer fixes absolutely the date upon which the instrument was in existence and in force. This is often a most important point. It is hardly necessary to say that every contract should be dated, and should contain in the body of it a clear statement as to the date when the contract became effective, its duration and its termination. All contracts should be executed at least in duplicate, and no one should ever allow any contract which has been signed to go out of his possession without retaining either such duplicate original, or a copy thereof which is absolutely correct. In these days of carbon copies, it is quite common to consider a copy complete which contains only the body of the contract. All original dates and signatures should also be copied upon the carbon reproduction.

Having considered the questions preliminary to or connected with making a contract, we now pass to the consideration of subsequent rights and liabilities thereunder.

TERMINATION BY LIMITATION OR CONSENT.

It is quite possible that some change of circumstances may occur which makes it desirable to terminate a contract, or some dispute may arise in respect thereof. Even this brief examination of contract law would therefore not be complete unless we gave some consideration to the methods of terminating a contract, and the cancellation of the rights and liabilities thereunder, either with or without the consent of all the parties thereto.

In practically every contract, executory in form, a date is fixed for its expiration. At such time all rights and liabilities under the contract cease, unless the agreement be further extended by mutual consent, or displaced by a new one. It is hardly necessary to say that a contract is terminated when fully performed, and may also be terminated prior to the time fixed for its expiration, by the joint consent of the parties thereto. If, therefore, it becomes apparent after making the contract, that it is mutually unsatisfactory, it may be so abrogated. No trouble will be experienced if the parties are in accord. A contract which has been made in writing should be cancelled with as much formality as was evidenced in the original agreement, and the parties thereto should make certain that they receive proper releases of all liability thereunder. In the same manner that a contract may be cancelled, it may be modified or amended by mutual consent.

TERMINATION BY LEGAL MEANS.

Serious difficulty arises, however, in respect of the alteration of agreements or their cancellation when consent cannot be obtained.

Notwithstanding all the precautions which we may take, it sometimes occurs that a party to the contract feels that he has been misled in entering into a contract; that he has not been fairly treated; that the contract, as drawn, does not represent the real intention of the parties, or that there has been some mutual mistake of fact made by the parties, which renders the contract unprofitable. In a still greater number of cases there is a violation of the terms of a contract for which redress must be sought.

These questions are all interesting and will repay some consideration.

As we have seen in certain cases, a party to a contract may rescind the entire contract and be relieved from further liability thereunder, even against the will of the other party to the agreement. The chief examples of this, some of which have been considered in connection with the subject of the essentials to a contract, are as follows:

1. Where it appears that there is no consideration for the contract.
2. Where the contract has been induced by fraud.
3. Where the contract is impossible of performance.
4. Where there has been a mutual mistake of fact in regard to the subject matter of the agreement.

1. We have previously spoken somewhat at length of the necessity for a valid consideration in the contract. If it shall be found after the contract has been made, that no real consideration exists, the contract is unenforceable. Many examples of this will suggest themselves, for example: A might agree to perform some act for B in consideration of the latter's agreement not to compete with A in business in a certain locality. A might subsequently discover that B was already under agreement to avoid that territory, so that in fact B had given nothing which he was not already under obligation to perform. There being no consideration for A's agreement with B, he would be entirely justified in refusing to perform his part of the contract.

2. By far the most important ground for abandoning or rescinding a contract is that fraud has been present in its inception. If it be found, therefore, after making a contract, that a party has been wilfully misled with intent to cause him to enter into a contract which he would not otherwise have made, he may cancel the entire agreement. It is difficult to prove the fraud which must necessarily be present in order to impair a contract. The essential facts which must be established are as follows: It must first be shown that false representations were made by the individual with whom the contract was made; that these representations were accepted and led to the making of the

contract; they must have been made about a material fact and for the purpose of promoting the agreement. Most important of all, the individual making the fraudulent representations must be shown to have known that they were false. This latter requirement is the most difficult to meet.

One who would rescind a contract upon the ground of fraud must return any benefits received under it. He must place the other party to the contract in the same position which he occupied when the contract was made. If, therefore, he has placed himself in such a position that he cannot do this, his right to rescind the contract is destroyed. The law will not permit a man to receive wholly or in part the benefits of the contract and escape the liability of performing his duty thereunder.

3. One may be relieved from a contract which is impossible of performance either at the time the contract is made, or by the happening of some subsequent event, provided it was not known at the time the contract was made that such impossibility existed. Otherwise, he may be held liable in damages for his failure to perform. Where, however, a contract is entered into innocently, the law will not permit a man to suffer by reason of the fact that performance is impossible. Mere difficulty of performance, although it may be great, and the loss which he suffered heavy, will not excuse performance, nor will a temporary impossibility.

4. Rescission on the ground of mutual mistake of fact has been sufficiently considered under a previous subject.

Upon any of the foregoing grounds, the contract may either be said to be void, or may be rescinded.

REFORMATION.

It sometimes happens, however, that the maker of a contract does not desire to go to the extent of rescission. Perhaps he feels that the contract, as drawn, does not accurately express the real intent had at the time it was made. In this event the aid of the court may be invoked to re-form the contract so that it shall accurately present the intent of the parties. This is always a more or less difficult task, however, unless the contract is clearly

incomplete or insufficient. The general policy of law is that a contract in writing cannot be varied by parol evidence. That is, one cannot take a contract complete in itself and say that something different from what is expressed therein, was intended. There is only one case in which the court will allow this to be done. If the contract is ambiguous or insufficient in its phraseology, so that it cannot be determined from the instrument itself what the real intention of the parties was, the court will receive evidence upon this point and will readjust the rights and liabilities under the contract accordingly. The rules of construction will be considered presently.

BREACH OF CONTRACT.

We now pass to the general question of breaches of contract and the results which follow therefrom. A breach of contract occurs when one of the parties thereto fails to perform a material part of the agreement. A failure in an immaterial or insignificant portion thereof is not a breach. The breach of a valid contract always gives rise to an action for damages sustained by such breach and in many cases, if it be apparent that a breach of contract is contemplated, the court will interfere and before the breach be committed will prevent it by injunction. These two forms of relief must be clearly separated in mind. When the damages which follow a breach of contract may be measured and determined and the party causing the breach is financially able to respond in damages, the only remedy is to sue him at law for the amount of the loss which is sustained. If, however, such damages cannot be measured nor can any money which may be recovered recompense for the loss sustained, or where the wrongdoer is financially irresponsible, an injunction will lie to prevent the threatened injury. A few examples will illustrate this statement.

If A agrees to employ B at a fixed salary and refuses to do so, while B is ready and willing to perform his contract,it is clear that the damages which B sustains arise from the loss of his remuneration. Ordinarily, no action can lie against A save to recover the amount of the agreed compensation. Let us sup-

pose, however, that A has agreed not to cut down a large tree standing upon his property which gives shade to B's house. It is clear that if A does so, the damage cannot be repaired. If B sees A about to commit the violation, he may stop it by injunction. Again, A may have agreed with B to permit him to use his laboratory for scientific experiments. B cannot obtain the same accommodations or facilities elsewhere. His damage will be irreparable if A does not fulfill his contract. B may therefore restrain A from removing his laboratory and force him to permit the use of it. Again, suppose that A has agreed not to practice his profession in the same town with B, and proceeds to do so. It is clear that the damage sustained cannot be measured in money and the court will grant an injunction to prevent the threatened act. Lastly, suppose that A has agreed to give B an exclusive license to sell a patented article in a certain city, and B finds that A is encroaching upon such territory while it appears that A is financially irresponsible. It is evident that although it may be possible to determine just how much has been lost through sales which A makes, which amount could ordinarily be recovered in an action at law, the fact that A is financially irresponsible will prevent such relief from being efficacious. A may be judgment proof. In this case the law will grant an injunction to prevent the unlawful act.

This power to go beyond the mere question of damages and to restrain by injunction, is called the equity power of the court. It is very jealousy exercised and may be only invoked where the ordinary remedies are unavailing. Nor can a man ever invoke the assistance of a court of equity, unless he is himself free from all blame in the premises. There are two maxims of equity which may be remembered with profit: "He who seeks equity must do equity" and "He who enters a court of equity must come with clean hands." Be the complaint never so meritorious or the case sound at law, help will be refused unless the complainant can show that he is himself free from blame.

It must be remembered also that whether suit be brought at law or in equity the complainant must always show a readiness upon his part to perform his obligations under the contract.

There are some exceptions to this rule, but they so rarely occur and are of such a technical nature that we need not consider them. Benefits under a contract can never be claimed unless obligations be performed.

In some cases it may be that performance of a contract is prevented by the other party thereto, or that by his act performance of the contract has been rendered impossible. In any case one must be *ready* to perform if he would enforce his rights.

Thus, if one contracts to work for another, and employment is refused, the remedy is for the amount of the agreed wages or salary. But this amount cannot be recovered, should it appear that, upon the refusal to employ, the employee entered the service of someone else. In other words, he cannot receive double pay. If he recover his agreed wage he must deduct the amount received during the time for what the employer is held liable.

Construction.

We now pass to the last of the important considerations in regard to contracts, namely, the rules for the construction of such instruments.

The methods by which contracts are construed by the courts is a matter so closely within the sole knowledge of practicing lawyers that the layman it not qualified to pass an opinion upon it. Two or three examples will suffice to explain this. When two persons enter into a contract they have in mind not only the terms of the particular instrument, but as well, a large fund of knowledge personal to themselves, which they read into the paper and perhaps feel may safely be omitted from its phraseology. Some facts they may deem to be so well known, both to themselves and to the other parties to the contract, that to express them would be surplusage. When, however, the contract is taken before a court of justice for interpretation, it may be found that the other parties to the contract have conveniently forgotten these facts and deny their existence, and the point at issue may be deemed by the court controlling. This is the situation which occurs in practically every contest over a contract. A sharp divergence of opinion is found as to what was really meant at the time of execution.

It is well, therefore, to make certain, before signing a contract, that its phraseology is so clear, its terms so explicit and its contents so full that it may be submitted to any court, before which it may be brought, containing in the body of the instrument itself, all the facts which are necessary to support the desired view of it.

It must also be remembered that many expressions commonly used in contracts have a widely different significance in a court of law from their popular meaning. Furthermore, it is frequently the experience of litigants that they find obligations imposed upon them by the terms of their contracts, and which are implied from provisions stated therein, which were never in contemplation at the time the instrument was made. It is a lawyer's business to pass upon all these points. If an attorney be wise, he will neither draw nor pass upon a contract until he has first satisfied himself of the surrounding circumstances, and in many cases of the details of his client's business, in order that he may judge whether sufficient is expressed in the contract to guarantee its enforcement in a court of justice. Points which may seem insignificant to the client may seem important to him, and so prove if the contract be under fire. No one, therefore, should lose patience with an attorney if he seem to ask questions which the client may deem irrelevant and superfluous. It is a sign that he is in good hands. It is much better that the attorney should know too much than too little. No attorney should ever be employed who cannot be trusted with the minutest details of a profession or work.

Many disputes arise from the fact that the parties to a contract are mistaken in their ideas of their obligations thereunder. Without advice they assume to act in a manner which they deem justified by their contracts, and which in fact is in violation thereof. At times a failure to comprehend the true meaning of a contract may be excused upon the ground of the inherent difficulty of the case. More often, however, a few moments' careful consideration of the contract, prior to action, and even a slight knowledge of the rules by which such instruments are construed, would have prevented the violation. If, therefore, after making the contract the question arises whether a certain proposed course of action will

be in accordance with the contract or in violation of its terms, the instrument must be considered, not in the light of personal wishes or even of individual opinion. If a dispute arises between the parties to the contract it will not be settled by any such authority as this. The court will adjust the differences between the parties and construe the contract in accordance with well established rules. An attempt must be made to regard the contract as the court will regard it. It is desired to give a few practical suggestions upon this subject.

In the first place, when a contract comes before the court for interpretation, examination will be first made of the instrument itself, for so far as the agreement is clear and unambiguous the court will give to it full force and effect, nor will it allow any explanation to vary or alter the explicit statements made therein. This is obviously upon the theory that the parties were presumed to know what they did at the time they entered into the agreement, and when their intention is clearly indicated it must prevail however burdensome or disagreeable. Thus far the interpretation is comparatively free from difficulty. It frequently happens, however, that while the question in dispute is partially covered by the terms of the contract, the phraseology of the instrument is susceptible of two or more interpretations. It is then the province of the court to determine what was really meant by the language employed. There are a number of broad rules to guide the court.

1. The words will be given their ordinary and commonly accepted meaning, unless it appear from the circumstances of the case that they were used in a special sense.

2. Where the subject matter of the contract concerns a particular trade or business, words having reference thereto will be given the meaning usually ascribed to them in such business or profession.

3. The court will take cognizance of particular uses or customs affecting the subject matter of the contract.

4. The court will endeavor to ascertain from any possible source what the real intent of the parties was, and give force and effect to that intention.

This last rule is the most important of the four, and comprises in a measure the other three. If the court can once determine what the parties really meant it will conform the contract thereto, no matter what the actual phraseology may be. The first three are in reality aids to arriving at the last.

It frequently happens that the subject in dispute is omitted entirely from the contract, and the court is then remitted to the necessity of determining what is fair and equitable, having in mind the whole contract and the circumstances surrounding it. In other words the court will say that if the question had come up at the time of making the contract, it would have been disposed of by the parties in general conformity with the rest of the agreement.

It is hardly necessary to say that it must appear that the matters omitted from the contract should have been included therein in order to justify the court in interfering. By that is meant that it must be so inseparably connected with the contract and so bound up in it that it may justly be claimed that it is implied in the instrument itself. Mention has been previously made of the fact that it frequently happens, in making a contract unadvisedly, that the parties find obligations imposed upon them by implication which they did not consider at the time the agreement was made. In passing upon such points as this the court applies much the same rules as in cases of ambiguity. In the last analysis they are determined by the intent of the parties and the principles of fairness and equity. If, therefore, a doubt arise as to obligations or rights under a contract, and the point in question is not found to be clearly stated in the instrument, the best test which can be applied, in order to determine action thereunder, will be to attempt to take the position and viewpoint of the other party to the contract. It should be considered whether from his standpoint the course of action which is proposed would be fair and equitable, and in accordance with the general intent, as disclosed from the whole contract. Let the question be asked whether, if the positions were reversed, such action would be permitted. If this be done honestly, both sides of the question will be argued with equal vigor, and an attempt will be made to arrive at a decision which is in accordance with what is fair and just. If the contract be called before a court of law and an attempt made to justify a given action, the course pursued will be determined by these principles, and their dictates might as well be observed before as after. Incidentally much trouble will be saved.

It is a difficult thing to take an unprejudiced view of facts in the face of personal interests, but the attempt to do so should be made, if not from higher motives, because it is certain that in the long run it is more profitable to do so. Above all, one should not be carried away with the idea that because a contract may seem without flaw or defect it will prove sufficiently strong to justify an act which is not in accordance with these principles or which will make it possible to obtain an undue advantage over an associate.

Conclusion.

Such are the salient principles of the law of contracts. There remain only one or two observations, which are in the nature of general advice.

Above all avoid, if it be a possible thing, litigation over contracts. It is better to surrender at times very substantial advantages rather than to undergo the dangers and difficulties of a lawsuit. Though one may win eventually, it too often occurs that, despite the best efforts of the most competent attorneys, the ultimate victory will be fruitless. Litigants are involved in heavy expense and tedious delay. Their business may, meantime, be at a standstill, and they may, while in pursuit of fancied gain, lose very substantial present advantages. Like every other business question, when one is faced with litigation he must weigh whether the advantages which he will gain outweigh the certain disadvantages which he incurs.

Unfortunately, there are too many cases where litigation cannot be avoided in justice to one's own rights, and with proper regard for one's own interests. The number should not be increased unnecessarily. He who is forced, however, into litigation, should make up his mind to pursue it until he has either obtained

his rights or a final decision of the highest court is rendered against him.

The writer has endeavored in presenting this subject to give only general principles, and to avoid embarrassment by technical details or a discussion of the more complicated points. In some instances principles which have been explained are subject to minor exceptions. As it is especially desired to make these notes of practical benefit, it will be found that at times the writer has not been content to simply state the law, but has made suggestions as to its application in everyday affairs. Technical accuracy has not been sought so much as a simple exposition of general principles, which at best are sometimes puzzling to the lay mind.

The most satisfactory result which could follow the publication of the foregoing pages would be to provoke the comment that they set forth nothing more than principles of ordinary right conduct and common sense. Of these the law should, and aims to be, the exponent.

It is obvious that the principles of the law, however well fixed, must be applied to such a wide variety of cases that they appear to assume different forms. It sometimes seems to the layman that distinctions made by courts and lawyers are more fancied than real, and at times the application of legal principles seems in individual cases to work hardship. It is only a superficial observer who joins the ranks of those who would complain of the technicalities of law or the difficulties and delays in its administration. The science of law is founded upon theories and teachings which are above and beyond any individual case. In the last analysis, the law is based upon ideas of fairness and justice which have been in process of development from the time when the Mosaic law was declared. If one could be absolutely certain that he could determine in any given case that which was absolutely fair, honest, straightforward and equitable, and in accordance with the greatest public good, he could be perfectly sure that ultimately his view and actions based thereon would be sustained by the courts of last resort.

The greatest lawyers have been those whose first thought in any case brought before them was always, "What *ought* the law

to be?" It is said that Daniel Webster before he would accept a retainer always considered, not whether he could successfully urge the contention of his clients but whether such contention ought to be sustained. If he could answer this question in the affirmative, he accepted the case; if not, he refused it. Almost all litigation in the last analysis arises out of an attempt by one or more of the parties concerned to act in defiance of the abstract principles of justice referred to. If, therefore, a man desires to be successful in his relations with those about him, which is only a broader definition of contracts, he should be certain that he so rules himself that he not only serves his own interests but that he respects the rights of those about him. It is a mistaken impression prevalent in the minds of many that the only duties which are owed to our neighbors are those which are enjoined by printed statutes.

Before the statutes were ever conceived the principles which they set forth were found in the moral law, which contained and contains not only those matters which have become the subject of legislative enactment, but also those ideals of duty and uprightness which cannot be set forth by written words, and which speak most loudly and with a most conclusive force in the individual conscience. To think that these latter may be ignored with impunity is a false idea. Sooner or later in the affairs of business, men will be called upon to square their actions with these precepts. If they are unable to do so the chance of ultimate success is small; but conscious that he has acted in accordance with their teaching a man need not fear to submit the contracts and agreements of daily life to the judgment of any tribunal.

GENERAL NOTES.

OCTOBER, 1904.

In each of my classes, I have found that certain of the men had already received some instruction, more or less complete, in bookkeeping. I am always glad to find that there are some of our students who have been thus benefited; but let me say to them that they can still well afford to give close attention to these lectures. They can get more from them than can those who have previously had no instruction in this line; for they are better prepared to digest the matters placed before them and they should be more keen in their appreciation of the value of such instruction. Their minds have been prepared for this line of instruction, and this is a point, the importance of which will be appreciated more and more as knowledge is gained in the school of experience. The value to the individual of advanced instruction depends upon how completely the mind has been prepared therefor by previous elementary instruction and experience.

But apart from all of this, you will find that I am covering in these lectures much that is outside of bookkeeping, and much which the bookkeeper and even the accountant would not be competent, through lack of special training, to give you. As a warning, I may say that in my previous classes I have found that sometimes the men who had received instruction in bookkeeping before coming to the Institute made a poorer showing in the examinations than those who had not had this previous advantage. Probably this was because they thought that they were so fully informed that it was not necessary for them to make any effort to follow the subject with me. Perhaps it is already apparent to many of you that much that is of value in my lectures comes out incidentally through the informal statements of my own experiences by way of illustration.

What you are looking for, we can assume, is real success in your chosen profession. Then certainly it will be of assistance

to you if you can draw upon the experiences of one who probably has had to meet nearly all the difficulties that you have had and will have to meet, and perhaps some in addition, and is anxious to give you as far as possible the opportunity to avoid his errors.

You should be interested to know what an employer is looking for in the employe. I can give you, in advance of your graduation, information in this direction; and I can give it to you because I was, for many years, a salaried employe and for many more years a salaried employe while also a large employer of engineer-assistants, and still later, an independent employer of technical graduates. While, of course, employers are governed by varying ideas in making their selections, I can state to you what I have been in the habit of looking for; and I am inclined to think that today, in connection with the keen competition which is now a feature in nearly all lines of industrial work in this country, many employers are guided by the same views.

I would select, first, for honesty, then for thoroughness and then for energy and earnestness. First of all, I do not want any man in my employ unless he is honest in his intention to work wholly in my interests. Secondly, I do not want him unless he will do the work assigned to him thoroughly, even if the quantity of work is not large. Lastly, if I can get a man who is honest and thorough, and also is endowed with energy and earnestness, in other words, has a large capacity for work, I know then that I have a man who will meet all reasonable requirements. Many young fellows, and Stevens Institute men among the number, soon give up the employment which they first secure after graduation because, as they have often expressed it to me, they saw no chance ahead; whereas the facts are that they have not yet secured a thorough command of the minor details to which they had been assigned. The young graduate should be very slow to turn away from work to which he is assigned because he sees no advantage to himself in doing that work thoroughly. To him, the work seems unimportant, but on this point he is not yet competent to judge. It may be

that his employer is primarily or incidentally testing him as to thoroughness; is testing him with what appears to be work of little responsibility. The man who performs any duty, no matter how humble, anything less than thoroughly has no right to expect promotion. The employer who would promote such an employe does not deserve loyal service.

I told last year's class of a case which, at that time, had just been called to my attention. Three young graduates were employed by a certain industrial concern and put to work at all sorts of rough detail work. They were well paid. One man resigned in a month or two because he said it was not work suited to the capacity of a man who had received a technical education; the second man stuck to it for a year or so, grumbling much of the time; the third man went ahead uncomplainingly, performing thoroughly and promptly every task to which he was assigned. This third man was transferred from one rough job to another for three years. Then the manager sent for him, reminded him that his two companions had left, one after a very few months, the other after twelve months. He then asked this third man what had led him to go on with the work assigned to him. The young man replied something to the effect that he was perfectly satisfied with the fact that he was day by day gaining experience, day by day he found there was something to learn, and that he was confident from what he saw of the management that there would be a place for him, if he could prove that he was competent to fill some one of the more important positions. The manager then told him that his services were satisfactory, that he would now be pushed forward to higher positions, and at the end of two more years he would be placed in a position of authority and responsibility if he continued as he had begun. The result was at the end of five years this young man was drawing a salary of $5,000 a year, this salary being warranted by the fact that he was competent and in sympathy with the Company's scheme of management.

There are some who are perfectly willing to do the work assigned to them and do it thoroughly, but who do not go beyond this and seek for opportunities to take on additional work or to further cultivate their powers in the school of experience. These

men, lacking in ambition, initiative, or in robustness of mind or body or both, will probably continue to fill minor positions. But their lives are successful as compared with the lives of those who have the desire and push to go higher but are not willing to perform the necessary preliminary drudgery.

I am continually brought in contact with men who attempt to justify their incapacity by claiming that they are men of breadth; that they employ narrow men to do their detail work. The facts, probably, are that they have no real capacity except to steal the product of other men's brains.

Do not misunderstand me. I am not advising you to be narrow men as opposed to broad men. Add breadth to your make up as far and as fast as you can. The men who do each piece of work thoroughly *and then try to learn how to do something else just as thoroughly will gain in breadth.* The narrow man is the man who is satisfied with the thorough performance of one narrow line of work.

There are many men of breadth who do employ men to do special work for them, work which perhaps their employers could not do as well for themselves; but, almost without exception, these men are masters of detail in *some* lines and so govern themselves by an appreciation of the necessity for accuracy and completeness of detail in all lines.

I have more than once had Napoleon quoted to me as the personification of breadth; I then quote him back as the master of detail, not only of one department in army management, but of every department. He knew what could be accomplished and the best means to adopt therefor.

The fact that there are superficial men who flatter themselves that they are broad, and who succeed in making money through reckless push, should not encourage us to believe that it is not desirable for a conscientious man to pass through the drudgery of the training period. For one of the former type who succeeds there are hundreds who can be found sliding more and more rapidly down hill, perhaps starting from watching the "ticker" in a broker's office and winding up as the shabby-genteel tramp, or worse.

The privates in the army of promoters are largely of this class, and many of those who succeed as *money makers* do so because they are willing to risk the money of their friends and dupes. With them it is a case of "Tails I win, heads you lose."

Believe me when I say that employers find it quite as difficult to secure competent employes as men out of positions find it difficult to secure satisfactory employment. Intelligent employers are constantly on the watch for their young employes to betray their inner selves. The youngster may be doing some very simple work, but if the intelligent employer sees that the work is being done thoroughly and with energy, the chances are that a mental note will be made that that fellow is capable of doing something larger.

Young men who want to secure remunerative employment must be willing to go where that employment calls them. Those who insist upon being located in the vicinity of New York—for instance—must be willing to recognize that their chances are accordingly reduced.

One of the great troubles with young men—and older men too—is that they do not complete their work. When they meet with a problem which they cannot at once see how to solve they fall back on the man above to make good their deficiency, not recognizing that it is their duty to go ahead and do the best they can and *go as far as they can without assistance.* Let me quote from Mr. Kerr's admirable address to the last graduating class: "This is about the time to show your nerve. Don't be dazed or baffled, but make a start. Use your wits and you will get somewhere, and if you cannot always see the end it will constantly get nearer and plainer when you go as far as you can and then see how far you can go."

A friend of mine last summer had an experience in this direction. He was engaged in a most important piece of work. His strength was greatly reduced by ill health and he was anxious to tax his strength as little as possible, and therefore to do little more than direct the work of others. But he found that his chief difficulty was to get any one employe to finish up any one piece of assigned work. After working four or five

months on this case, he told me that there was only one man of the whole lot who had completed any one piece of work assigned to him, and the result was that his health was again broken down by the work entailed in making good the deficiencies of those who were paid to do the work; and these men were specialists in the lines for which they were employed. In such surroundings see how the thorough man shines out.

Let me give you an example from my own experience. It has to do with a day laborer, but the principle is exactly the same. Years ago I had undertaken to push through a piece of outside work which had to be completed within a given time or the result would be a considerable loss to my company. My directors were reluctant to have me undertake the work, feeling certain that it could not be completed within the time limit. I took on a large force and organized it in squads for different classes of work. One part of the work, and a very important one, was to fill in the excavations as fast as the work under the surface had been completed. After a day or two, I noticed that a young Scotchman only recently landed and quite green at the work, was the only one who could be relied on absolutely to follow my instructions in this class of work. The work to be done was easy to understand; the trouble was that there was so much drudgery connected with it that the majority of the men would neglect it unless constantly supervised. I soon found that this man's work was not neglected, whether I was looking on or whether I was in some other part of the field. After a few days, I took him to one side, told him I was satisfied with his work and asked him if I could rely on him to boss a small gang, if I placed that department of the work in his hands; that I would back him up, but would he be willing to tell me of the facts if the men neglected their work and if his authority was disputed. He expressed confidence in his ability to satisfy me, and I placed him in charge as a sub-foreman. The result was that that part of the work was done thoroughly and *never gave after-trouble.* The outcome was that this man, instead of being laid off as the other laborers were at the end of this particular job, was taken into the works and given steady employment at

an increase in wages of 33 per cent. He was then given an opportunity to learn the details inside the works and secured employment for life at good wages.

I quite appreciate that my arguments in favor of thoroughness do not appeal to the highest motives. But there is nothing wrong in a man trying to advance his interests and it is his duty to make himself so competent that he will never be a charge on his friends or society. A duty well performed from lower motives frequently leads to the development of higher motives.

Recently I have had drawn to my attention a number of times the fact that young engineer-students do not really appreciate what their technical education is doing for them. For instance, in a recent interview with a man who graduated last year, I was informed that he had learned more in three months, running a small plant and being made responsible for the care of the plant, than he had learned during the four years at Stevens Institute. This is a sample of many cases of a like nature which I have had forced upon my attention. This young man failed to see that it was largely because of his training at Stevens Institute that he was able to so quickly learn to run this plant. It was his training at "Stevens" which had qualified him to make this rapid progress in the school of experience. Without this preliminary training, he might never have been able to learn what he had thus learned in three months.

This lack of appreciation for the part which the college training plays in a man's after life, and especially, his success, is not, by any means, confined to the technical graduate. We frequently hear men say that they are unable to put their fingers definitely upon anything for which they can thank their college training. No doubt this is true, in a measure, with many men who neglect their opportunities; but the man who is so inclined to question the value of a college training should bear in mind that it is not the facts stored up which are of so much value, but it is the cultivated capacity for straight thinking and reasoning. The technical graduate especially should have this point in mind when he is inclined, in his pessimistic moods, to feel that he has wasted

four years devoted to technical study. Even the man who takes up employment in a branch of engineering which has not been specifically covered by his college course will find upon consideration, if he has any powers of analysis, that it is the preliminary and fundamental training in science and mathematics which has qualified him to take up, with confidence as to his ultimate success, his particular specialty. And this brings me to another point which is frequently urged against the value of a college training, and very often urged against the value of a technical training.

You hear it said that men of high scholarship do not often succeed in life. It is true that men who have gone high in scholarship frequently are not successful in practice. If so, this is because they have failed to learn in the school of experience; for, as I have said, you must bear in mind that the work in the school of engineering must be supplemented by equally conscientious work in the school of experience. To graduate at "Stevens," a man must pass 60 per cent. in every study. If our 60 per cent. men succeed in after life, as compared with those of a higher grade of scholarship, it is that by reason of their personal characteristics or their environment they take better advantage of the opportunities afforded in the school of experience, and so they secure in that school such a high per cent. that, averaged with their low grade of 60 per cent. in the technical school, their general average is still high. Whereas, if the technical graduate who has secured a 90 per cent. average in the school of technology neglects, through one cause or another, to pursue his studies in the school of experience, fails even to get a passing-mark in the school of experience, his general average will still be low as compared with that of the man who secured a 60 per cent. grade in the college and a 90 per cent. grade in the school of experience. This does not apply in the same degree to the men who graduate from an institution like Oxford and then continue to work in some of the fields of higher scholarship, if they work at all. Naturally, then, the high grade obtained in the college follows them through their work in life.

As I am constantly trying to show you men, the technical education that you get in a school of technology must be supple-

mented by the training that you will receive in the school of experience. The industrial manager of today must be a man who has had the opportunity in both schools and has taken full advantage of all his opportunities. In this connection, let me refer to a point which I have had forced on my attention a number of times since I have been president of the Institute. As you know, we are in the habit of calling in engineers from outside to lecture to our upper classes on some special features in engineering practice. We frequently call in some of our own graduates. I have listened to a number of these lectures given by men who are essentially engineers; that is, they are responsible more particularly for the strictly engineering side of their business than for the commercial side. Still I have noticed and drawn to their attention, and received their acknowledgment of the truth of my observations, that one-half to two-thirds of each lecture is devoted to the practical features of their work, and especially to the questions of commercial limitations under which they have been called upon to operate.

Therefore, to give your technical studies their full value after graduation, you must be prepared to quickly acquire in the school of experience the ability to practically and efficiently apply your theoretical knowledge, but you must also quickly learn in that school what the business world requires you to know and do.

It is to prepare you for this part of your work in the school of experience that I am taking up with you the work of my special department.

ACCOUNTING.

OCTOBER, 1904.

In the reprints of lectures and magazine articles which you have been required to read you have been furnished with sufficient reason for my claim that the engineer should be prepared to practice his profession within the limits set by commercial conditions, and that also the engineer should be familiar with business methods and practice. Especially, he should know the language of business; namely, the language of the accountant. Without this knowledge of the language of the accountant, the engineer is unable to read the statements that give the final result of the enterprises in which he is engaged except through the employment of an interpreter; or, in other words, he must take on faith any and every statement which his and other men's bookkeepers and accountants make to him. For instance, referring to Mr. Turnbull's lecture, at the bottom of page 25 of the Reprints he says:

"We will suppose that we are doing a simple merchandise business, buying and selling. We shall have *charged* all our *purchases* to Merchandise Account, and we shall have *credited* all our *sales* to Merchandise Account. We will assume that our *purchases* have amounted to $100,000, and our *sales* to $90,000, but we find upon taking an inventory that we have goods on hand worth $25,000. Now, if we add the $25,000 to the $90,000 at credit of Merchandise Account, we have $115,000 as against a cost of $100,000. It is evident to you, therefore, that we must have made $15,000 profit. But to arrive at that in bookkeeping fashion, we debit Merchandise Account with $15,000 profit, and credit Profit and Loss Account, bringing down a balance to the new Merchandise Account of $25,000, being the $10,000 balance already at the debit plus the $15,000 profit charged, making $25,000 as the value of merchandise and the debit to Merchandise Account with which to commence the new fiscal period. Now we find that we have $15,000 to the credit of Profit and Loss,

but we have various expense and other debit accounts affecting the result of the business, and we debit Profit and Loss and credit these various accounts with their respective amounts; (we may have also credit balances to other accounts, such as Interest—affecting the result, and these we credit to Profit and Loss), and assuming that as a net result of these various debits and credits to Profit and Loss we have a balance of $10,000, this then is the net gain for the year, and we transfer it to our individual account by debiting Profit and Loss and crediting our account."

I have found with this class and the two previous classes that this statement as written could not be followed by a majority of the students. I am certainly warranted in believing that the members of our senior classes (having been subjected to the "weeding-out" process for three years) are above the average in intelligence and ability to follow out a more or less abstruse proposition, but still the proposition here made by Mr. Turnbull is an extremely simple one. The trouble, then, is unquestionably in the fact that the students do not understand the language in which the statement is made. Part of Mr. Turnbull's statement is made in the language of every-day life and part in the language of the accountant.

Now, let me make this same statement, employing only the language of every-day life, and there is not a member of the class who cannot follow me.

Jones engages in a simple merchandise business, buying and selling. He purchases merchandise which costs him $100,000. Three-quarters of that merchandise, or what has cost him $75,000, he sells during the year for $90,000. The expenses for operating the business for the year amount to $5,000. He has, therefore, made a gross profit on his sales of $15,000, and it has cost him $5,000 to carry on the business in connection with those sales, leaving him a net profit of $10,000.

The statement as thus made a school-boy can follow. But here it is to be borne in mind that in business we must have a method of recording our results which is *concise and based upon principles capable of universal application.* If the engineer—and especially the engineer who engages in industrial management—expects to be able to read the statements of business results without depending upon outside interpretation, he must, then, as I have said, be able to read with some facility in the language of the accountant. In the example from Mr. Turnbull's lecture that I have given (and it is an extremely simple example and selected by him for that reason) we have proved that the statement could not be followed by a majority of the members of our senior classes without additional explanation or interpretation. But it is to be borne in mind that that statement is made only in part in the language of the accountant. We may assume then that if it had been made *entirely* in the language of the accountant it would have been absolutely unintelligible to those members of the class who had not already had experience in accounting.

I think, then, that this presentation of the subject, in connection with the facts and arguments which have been brought before you in the "Reprints," should convince you that a knowledge of accounting is not only important but absolutely necessary to the engineer who aims to satisfactorily fill any managerial position. Now, I do not expect to be able to make bookkeepers of our students. This is not necessary, nor is it even desirable. I only aim to give you such a knowledge of the principles of double-entry bookkeeping that you will be able to read without assistance the statements of results, for it must be borne in mind that unless, by detailed analysis of the statements of account, you are able to detect inefficient and uneconomical items in the management you are certainly unable to introduce corrections thereof. A competent analysis of accounts is at the very foundation of competent and economical management.

The bookkeeper is the man who is trained to do the actual work of bookkeeping correctly neatly and rapidly. He may be an admirable bookkeeper, but a very poor accountant. That is, he may be able, with accuracy and rapidity to follow the lines laid out for him by the accountant, but he may not have such an understanding of the principles and the details of the business as will enable him to lay out for himself the system of accounts.

Now, it is quite possible for the members of this class to obtain such a knowledge of the principles of accounts that they can direct such an expert bookkeeper as to the proper methods to be followed without having that expert bookkeeper's facility in the actual performance of the work.

I have been, more than once, told by young men who have taken courses in bookkeeping in the commercial colleges that they regarded it as time wasted, because the bookkeeping methods followed in different establishments so varied that very likely after having learned in the commercial college they would be required to take a position where these methods had no place. If this is a fair statement of what is done in some of the commercial colleges, it simply goes to show that those colleges teach methods and not principles. I am reluctant to believe that this is true. It is true that the methods followed in different establishments vary to a great extent. The methods followed generally in America are different from those followed on the Continent of Europe. But the same general principles are included in all systems of double-entry bookkeeping, and if our students get a firm hold on those principles they can, *with some little effort,* analyze the statements prepared from any well-kept set of double-entry books. It may be necessary to have the details of accounts, and the like, explained, but such explanations can generally be obtained when necessary.

Now, I have referred to the double-entry system, or the Italian system, as it is sometimes called. Mr. Turnbull in his lecture has shown that there are two systems, the single-entry and the double-entry systems. The single-entry system does not especially interest us, because it is only employed by retail concerns; or, perhaps, to be more accurate, it should be employed only in such cases. As will appear later on, the single-entry system does not afford any check as to the correctness of the transactions recorded, whereas the double-entry system does afford as complete a check as can be devised.

There is often some misunderstanding as to the meaning of double-entry in this connection. Let me say at once that it does not mean that for every entry made by the single-entry system, by the double-entry system there are two separate entries. It does

mean, however, that in every transaction the amounts involved appear upon both sides of the books, namely the debit side and the credit side.

To understand this a little better, let us go back. Every time that Jones made a purchase of merchandise in accumulating his $100,000 worth of merchandise stock, the man from whom he purchased made a sale, and every time that Jones made a sale of part of that merchandise, the man to whom he sold it made a purchase; that is, for every sale there is a purchase and for every purchase there is a sale. Or, for every credit there is a debit and for every debit there is a credit. And this is true even though each of these credits and each of these debits do not appear separately on the books of account. As you will later see, by the time the transactions are finally recorded on the Ledger, many credits and many debits may have been consolidated; but the fact remains that each side of each transaction will in time find its place in the final record. You know the old saying is that it takes two to make a bargain.

Then, in the double-entry system, in every transaction, in one way or another, both the credit and the debit sides of the transaction are recorded on the books. If Jones buys from Robinson $100 worth of merchandise, Robinson sells to Jones $100 worth of merchandise, and if both sides of the transaction are recorded, $100 appears on each side of the final book of record, namely the Ledger, and these two amounts balance each other; and this is true with all other transactions. Hence in this final book of record, if the books have been correctly kept and we draw off a statement showing the balance against each account we will find that the balances from the debit side sum up to the same amount as the balances from the credit side; or, if, as many bookkeepers do, instead of taking the balances we take the sum of the items on one side and the sum of the items on the other side, we shall again find that the sum of the debit items equals the sum of the credit items. If such a balance is not obtained, namely if there is a difference between the sum of the debit balances and the sum of the credit balances or between the sum of the debit items and the sum of the credit

items, we know that some mistake has crept into our work.

While it is true that in spite of the check obtained through this system and in spite of the care that may be taken, errors will creep in because two errors of a like amount may be made which will balance each other, or an amount which should be posted to one account may be posted to the *correct* side of another account, still, this does not disqualify the double-entry system, for after years and years of experience it has been found to afford as complete a system of checks as it has been so far possible to discover.

I have spoken of the final record as the Ledger. It might perhaps seem more in order if we first took up the primary records and then went on to the final record, but the result we are looking for is to be found in the Ledger. Therefore, I will first consider that and then work back from the result to the means employed to obtain the result.

If the members of this class who are interested in the Athletic Association had occasion to distribute against the several athletic teams certain items of expense they might perhaps take a sheet of paper and put down headings to designate the several teams. As each item was analyzed they might determine what per cent. thereof was to be charged against each team. Having determined the per cent., they would figure out and put under the proper heading the amount so determined. They would do this for each item to be distributed. Having finished this work of distribution or classification, they would foot up the amounts in each column and then, to check up as to the correctness of their work, they would see if the sum total of these several amounts as distributed in these several columns equaled the total of the column of items before distribution. In a simple case of this kind probably all the purposes would be served by such a method carried out on a loose sheet of paper, though it would be then preferable to make some final record in case some question might arise in the future. But in a business of any size, the amounts of money which are spent and the amounts of money which are received and all transactions in which no money actually passes, have to be recorded in

permanent form and by such a system that the facts can be shown at a moment's notice. If a man is owing us money and from time to time he is making payments thereon and is making further purchases from us, we must have one place where these several transactions can be summarized. That is, we must keep an account with him. Or, to speak in a more general way, to analyze the results of our business we must be prepared to determine what different branches of our operations have cost us, what the different branches have returned to us in income and what has been the final result either in profit or in loss. It will be necessary, then, to classify these different items under proper headings, these headings or titles of accounts to be self-explanatory as far as possible. These accounts must be so kept as to lend themselves most completely to analysis. Now the book in which the facts are so classified and summarized is called the Ledger.

In the double-entry system all debit entries are carried into the left dollars-and-cents columns and all credit entries into the right dollars-and-cents columns. This is the case with the Ledger and all the other regular books of account. Sometimes, as in the Ledger, this division is accomplished by dividing each page into debit and credit sides by a vertical ruling through the centre of the page. Sometimes, as in the Cash-Book, the two pages which open opposite to each other are employed as a couple, the left page for debit items and the right page for credit. Sometimes, as in the Journal, the debit and credit dollars-and-cents columns are side by side at the right side of each single page, the debit column, however, being to the left of the credit column. This is an arbitrary arrangement. If it had been originally decided to carry the debit items to the right side and the credit items to the left side, the accounts could have been kept just as accurately; but it is at once apparent that for general convenience there should be, the world over, a uniform practice in this regard. Luckily, this is the case.

But here comes in a point that is a frequent cause of confusion, especially in the mind of the man not very familiar with accounts. Suppose I am keeping an account with a man. If I

make out a statement of that account from my standpoint; that is, from my side of the transactions, the amounts which I have paid to him will appear on the credit side of my statement, and the amounts which he has paid to me will appear on the debit side of my statement. But, now, suppose that he, from his books, renders the statement of account to me. Then the statement is prepared from his standpoint and while the two statements may be correct and identical in every particular, not varying to the extent of one cent, still every item which on my statement of account appears on the debit side will, on his statement of account, appear on the credit side, and vice versa. Unfortunately, it is not always apparent from the heading of the statement from which side of the transaction the statement has been made. It is in such matters as these where the European bookkeepers are apt to be more generally uniform and precise than those of America.

To repeat, every item involved in our several transactions has been finally recorded in the Ledger and if the record has been correctly kept the sum of the items on the debit, or left, side will equal the sum of the items on the credit, or right, side, and unless they do so foot up to balance we must accept the fact that there has been an error made and we must look for and correct it.

Before passing on, let me urge you to consider carefully the point above made as to the reversal of the debit and credit items on the two sets of books as kept by the two parties to any one transaction.

It is necessary to fully appreciate this point to understand why a Ledger balances and why in posting from the Cash-Book to the Ledger, as later to be explained, the items on the left (debit) side of the Cash-Book are posted on the right (credit) side of the Ledger, and the items on the right side of the Cash-Book are posted on the left side of the Ledger.

We now come to the question, how are these items obtained for the Ledger? What is the basis for this final summarized record?

The system of primary records which forms the basis for the Ledger entries varies very considerably, but in general we may say that the three main books of account are the Cash-Book, the

Journal and the Ledger. Under the head of the Journal can be included certain subsidiary books, which perform certain parts of the Journal's duty.

Let us first consider the Cash-Book. Keeping track of our cash expenditures and cash receipts is, of course, of primary importance. Therefore, we are warranted in maintaining a special book for this purpose which will contain the facts in regard to each transaction in some degree of detail. In this Cash-Book each left hand page is for debit entries and each right hand page is for credit entries. *The debit and credit entries of even date are made on the pages opposite to each other.* If there are more entries of a certain date on one side than on the other, and so one page is filled up while the opposite page is only partly filled, the blank spaces are not filled, and the next two pages are opened with entries of even date. The reason for using a full page for debits and a full page for credits instead of dividing a single page into debit and credit sides, is because the record should be sufficiently in detail and it is desirable that the record should only occupy a single line.

Now let us first think of what we mean by Cash. It is an account kept with *ourselves.* If there was only one owner of the business, then Cash would really represent that owner. But, even then, Cash would have an identity of its own, as will be later seen. Suppose there are two partners to the business and each puts into the business $5,000 as capital. Then, certainly, when that money is put into the business for the benefit of both each man should be individually credited with $5,000. The business as a whole should credit each man with $5,000 and therefore the business as a whole should be debited with each $5,000 received. In the Cash-Book, which represents the business as a whole, these entries would appear on the debit side. When Cash receives money, that is, when the business receives money, it must debit itself with that receipt. On the other hand, when, in the course of business, Cash pays out money, Cash Account must be credited.

Even in the case of a business which is owned and controlled by a single proprietor, the owner of the business may be concerned in many other enterprises, but his relation to this particular busi-

ness must be clearly shown in the books of this concern. Cash Account has been made the custodian of this part of his money and, therefore, Cash Account must be debited and the proprietor *as an individual* is credited through an account which may be called Capital Account. This is more readily apprehended in the case of a stock company in which the capital is supplied by perhaps many individuals in perhaps widely varying amounts. Here it is evident that the business as a whole must account to each individual stockholder for the capital he has invested with the concern. The business as a whole has received the money and placed it in the Cash Account and hence Cash Account is to be debited and the individual stockholder is to be credited. This credit to the stockholders is generally shown in a general account called Capital Stock, or Capital Stock—Common, or Capital Stock—Preferred, as may be necessary to indicate the character of the stock obligation. The individual holdings are certified to by stock certificates issued to the stockholders. As these stock certificates are issued credit is given on a Capital Stock Ledger or Record; and as the certificates are cancelled, owing to transfer of ownership, the proper individual accounts are debited. This is a case of a supplementary or individual Ledger in which are given the details as to *individual* debits and credits, the general conditions only being shown on the General Ledger. It should be unnecessary to point out that the total balance shown by the Individual Ledger should exactly correspond with that shown by the General Ledger. The latter shows the amount of capital which the concern has to account for (is liable for), and the first shows who are the individuals who own the stock and to whom the company is liable.

Then it can be seen that Capital Account in any of these cases should be credited with the capital invested in the business. But the capital as received will be recorded in the Cash-Book, and as it is received by Cash, Cash will be debited. But we have seen that Capital (collectively and individually) should be credited. How is this part of the record made?

The entry on the Cash-Book is made on the left or debit side, and that shows that Cash is debited as it should be. But the descriptive matter of the entry also shows from whom the

money is received and why it is received, and therefore without any additional entry it shows to what account and to whom it should be *credited.* So we find that the one entry on the debit side of the Cash-Book also records the *credit* side of the transaction. This is an important point and must be fully comprehended.

Now let us follow through in detail the entries covering one of the payments made to Cash on account of capital. We will assume that we have to do with a stock company; the shares being $100 each and issued at par.

John Smith subscribes for 100 shares, for which he pays in to Cash $10,000. The entry is made on the debit (left) side of the Cash-Book—first the date received, then the title of the account (Capital), then the name of the man from whom it is received (John Smith), and then the amount ($10,000). In due time a stock certificate will be issued to Smith, and on the Stock Ledger he will be *credited* with the ownership of 100 shares of stock, the record including the detail as to the number of certificates issued, the number of shares covered by such certificates, and the serial numbers of the certificates. Probably a single certificate of 100 shares would be issued and the record would be so made, showing the serial number of the certificate for identification. This takes care of the liability to the *individual.*

When the other Cash-Book entries are being "posted" into the Ledger, from the debit entry on the Cash-Book (that is, debit to Cash because Cash has received the $10,000) Capital Account in the General Ledger will be credited with $10,000.

So we see that in posting from the Cash-Book to the Ledger we post a debit entry in Cash to the credit side of some account in the Ledger. And this reversal in the posting is due to the fact that we are taking note of both sides of the transaction; if Cash is debited for money received from John Smith on Capital Account, Capital Account must be credited and we must also record the fact that John Smith is the individual to whom the business is responsible for that part of the capital. We have now seen that Capital Account is credited on the General Ledger, and John Smith, the individual, is credited on the Stock Ledger.

This is not a double credit against a single debit as has been suggested by some of the students, because it is the General Ledger which shows the liability *as a whole* and the Stock Ledger shows how this liability is divided up. The Stock Ledger simply shows the details in connection with the more general record in the General Ledger.

But now it may be said, There is no double entry in the General Ledger; there is a debit to Cash Account which is recorded on the debit side of the Cash-Book and this debit has served as the basis for posting $10,000 to the *credit* of Capital Account in the General Ledger, but there is no debit entry in the Ledger to balance this credit entry to Capital.

To this objection I reply that in the General Ledger, there is kept, *or there should be kept*, a Cash Account. This account will represent Cash's side of each transaction; that is, the opposite side to that represented by Capital Account (or John Smith's Capital Account, if we kept all the individual capital accounts in the General Ledger instead of summarizing them under the general heading of Capital Account). Having posted the $10,000 entry from the debit side of the Cash-Book to the credit side of the Capital Account in the Ledger, it now remains to post the entry into Cash Account in the Ledger. But as this Cash Account represents the same side of the transaction as that represented in the Cash-Book, we post from the *debit* side of the Cash-Book to the *debit* side of Cash Account in the Ledger. But as *all* the entries on the debit side of the Cash-Book must be posted into the Cash Account in the Ledger on the debit side of that account and all the credit entries of the Cash-Book into the credit side of the Cash Account in the Ledger, we may as well wait until a number of them have accumulated and post them as a sum into the Ledger. The general custom is to "close" the Cash-Book once a month. During the month the individual items have been posted from the Cash-Book to the Ledger, item by item, to the several accounts involved, the debit items to the credit side of these Ledger accounts and the credit items to the debit side of these Ledger accounts. Thus we have classified or distributed the

several Cash debits and credits to the credit and debit of the accounts opposed to Cash in the several transactions of the month. Now we post the total footing of all the entries appearing in the debit columns of the Cash-Book to the debit of Cash Account in the Ledger, and we post the total footing of all the entries appearing in the credit columns of the Cash-Book to the credit of Cash Account in the Ledger. So we have, item by item, all the debit entries in the Cash-Book distributed and posted to the credit side of the several accounts in the Ledger and, item by item, all the credit entries distributed and posted to the debit side of the several accounts in the Ledger and all the debit entries of the month posted in *one* amount to the debit side of Cash Account in the Ledger and all the credit entries of the month posted in *one* amount to the credit side of Cash Account in the Ledger. So every entry in the Cash-Book has been posted on both sides of the Ledger; for every debit there has been a credit and for every credit there has been a debit, and so the balance in the Ledger between debits and credits is maintained.

Day by day, as the cash transactions are completed, that is, the money is received and the money is paid out, each transaction is entered up separately on the Cash-Book. Cash received is entered on the left page, namely the debit page, and cash paid out is entered on the right page, namely the credit page. The fact that debit entries are made to the left and credit entries to the right you have to memorize, for as I have said, it does not depend upon principle. It is an arbitrary arrangement, fortunately accepted by all so that uniformity of practice throughout the business world is obtainable.

Take another item: We may pay out money for the salary of the bookkeeper during the first month. That amount, being paid out by Cash, must be credited to Cash; that is, "Cash" has accounted to that extent for the money entrusted to it. But it must be charged against either the individual or some account which keeps track of this part of our year's expenses, say Salary Account or Expense Account, according to how we classify our accounts. Again you see that what is written up as a credit on the right side of the Cash-Book is posted as a single debit

to Salary Account in the Ledger: at the end of the month, the total footing of the Cash credit columns will be posted to the credit of Cash Account in the Ledger and this item of Cash paid to the bookkeeper will be included in this total. So we have all the credit items on the Cash-Book classified and distributed throughout the Ledger on the debit side of the accounts concerned and all these Cash credit items posted in bulk in the Ledger on the credit side of Cash Account.

Of course, there should be no reversal of the posting of Cash, because Cash Account in the Ledger means exactly the same as in the Cash Book; that is, we are considering the same side of the transaction in the Ledger that we have considered in the Cash-Book entries. From each side of the Cash-Book we have posted into the Ledger the implied side of each transaction, item by item. We have later posted to the same side of the Ledger as that in which the items appear in the Cash-Book the total of these items and so we have on the Ledger for every debit a credit and for every credit a debit, but we do not find them item by item. We find them in one case in bulk and in the other case itemized. That is, those amounts which on the credit side of the Ledger appear in itemized form, appear under Cash Account in bulk on the debit side, and vice versa. And so the Ledger accounts are in this case kept in balance.

I have written this at great length and repeated myself advisedly, for I have found in my classes that the students seem to have great difficulty in understanding why this reversal in the posting from the Cash-Book to the Ledger takes place. When they do fully comprehend this point, they will have secured already a fair idea of what is involved in double-entry bookkeeping.

ACCOUNTING CONTINUED.

NOVEMBER, 1904.

In this second paper on Accounting I shall deal more with methods than in the first paper, but I shall deliberately repeat myself in my desire to enforce a right understanding of principles.

As is my practice, I shall here try to answer questions which have already been suggested by my talks and I shall not regret it if I set your minds working on other questions.

Let me first repeat that I am not trying to make bookkeepers of you but to give you the opportunity to acquire a knowledge of Accounting.

Some of you have been puzzled at the distinction I have drawn between the accountant and the bookkeeper.

To be an efficient bookkeeper a man should be a good penman, writing a neat and legible hand and preferably writing it with some degree of rapidity. He should be able to accurately and rapidly add long columns of figures, preferably more than one column at a time. He should be able to accurately and rapidly perform examples in subtraction. He should have the ability and temperament that would enable him to concentrate his mental processes continuously for many hours upon details so that he will not be liable to make mistakes due to absent-mindedness, such as reading 657 and writing down therefor 756. He should have a certain sharpness and alertness of mind to enable him to quickly determine where best to look for the sources of error when his accounts refuse to balance. It will also be a great advantage if he has some inventive capacity which can so well be employed in devising labor-saving bookkeeping methods specially applicable to the business in hand.

To be capable as an accountant, much of this skill of hand and readiness of performance is not actually necessary. *The accountant must be able to direct the bookkeeper.* Therefore, he

should have a complete knowledge of the principles of accounting and such a sufficient knowledge of business methods in general as will qualify him to apply the principles of accounting to meet the requirements of any particular business. He should be able to recognize where his special training should be supplemented by the special training of the skilled business and technical manager. He must be competent to devise such a system of reports as will place before the management, comprehensively and in detail, the results obtained from the business. Thus it is seen that he must be much more than a bookkeeper.

It is true that most of our expert accountants are or *have been* expert bookkeepers. Through lack of practice in the actual performance of bookkeeping work they may have lost some of the mechanical and mental ability to perform accurately and quickly, but their thorough drill in bookkeeping is still of great assistance to them in the application of principles through methods to meet varying requirements and in the reading and understanding of books and accounts wherein the same principles have been applied by means of widely varying methods.

We may then liken the distinction between the bookkeper and the accountant to the distinction between the mechanic and the engineer.

Here at "Stevens," in training you to be engineers, we put you through a limited drill in the shops, not with the idea that we can during the limited time at our disposal qualify you as mechanics, but that we can give you some appreciation of the principles involved in efficient shop practice and of how the engineer's designs are realized in the shop. And in this connection you are shown in principle, if not in detail, that the engineer must modify his designs to meet the requirements of the most efficient and economical shop practice.

If before coming to "Stevens" the student has "served his time" as a mechanic, so much the better if he also has the mentality to be something more than a mechanic. Thus with this course in the principles of accounting, it is better if the students have had some training in bookkeeping; such training is not, however, necessary and is a handicap if it leads them to depend

upon their acquired knowledge of ***methods*** and so neglect this instruction in ***principles.***

Coming now to a consideration of some of the bookkeeping methods employed to meet the requirements of accounting, we see at once that these methods must provide a correct and permanent record of all transactions in which money or the equivalent has been transferred.

The scheme through which these methods are to be applied and the actual practice of the methods must be such as to meet the requirements just as far as is possible without making the bookkeeping of more importance than the transactions themselves:

1. The record should be completely self-explanatory so that at any time in the future the exact facts in regard to a transaction may be recovered without the assistance of memory.

2. All the transactions should be so classified that their combined effect over any given period or at any time during that period may be ascertained with ease and accuracy.

Let me acknowledge at once that these two objects are not easily attained; nevertheless, we should never be satisfied with anything less.

In the effort to develop a completely self-explanatory record, unless a controlling common-sense is continually exercised, a system of red-tape may be developed which will be out of all proportion to the actual requirements of the business. The engineer is constantly required to keep proportions in mind; here is an excellent place to exercise his developed faculty in that direction.

On the Continent of Europe the bookkeeping systems are often burdened with red-tape. The same record is often repeated in various forms. Facts which are fully developed and recorded in books outside of the regular books of account are again recorded ***in detail*** in these regular books of account.

In Great Britain and, I believe, still more so in this country, such costly repetitions are more often avoided.

There is something to be said in favor of each system. By what we may call the continental method, the full record is to be more nearly found in the regular books of account and,

clerical labor being cheaper, the additional cost is not so serious as it would be with us.

Here we save time, which costs money, and for the ordinary run of business our records are less complicated.

But in connection with our practice it is of still greater importance than with the continental practice that all our letter copy-books, invoice copy-books, contract books and all subsidiary and statistical book records should be accurately kept and carefully preserved for reference in case of future question or dispute making it necessary to follow the condensed record as found in the regular books of account back to the primary and subsidiary records.

We are now naturally led to consider the question—What are the books usually employed in double-entry bookkeeping?

No matter what the system of bookkeeping, certain books should be kept for our safety as well as for our convenience, such as letter-press copy-books in which *every* letter and every accompanying exhibit or enclosure should be copied unless the enclosures (invoices, for example) are of such a nature as to suggest that they be copied in a special press copy-book. In one book or another, all of our communications should be copied (preferably press-copied, as then we have a facsimile copy) before they are sent out.

There are other books of record, or statistical books, which will differ in function and form according to the business for which they are designed.

Under this last head might be included the contract record of a contractor in which should appear first a memorandum of the chief features of the contract and a specific reference to the book in which the full text of the contract is recorded. Then should be entered all the items included in the contract, and there should be appropriate columns in which to record against each item the date when ordered, when shipped, when received as shown by the *actual acknowledgment* of receipt, the cost including freight and cartage, &c., &c., and finally the total cost of each item. In passing, let me point out that such a record is of inestimable value to the contractor provided it is conscientiously kept up and always made to finally agree with the record as found in the regular books of account; that is, with the Treasurer's figures of cost. Such a record affords the opportunity to check up estimates of cost with the itemized records of cost in the case of completed contracts and it also continually reminds us of the wisdom of tabulating in advance all the items required in a certain contract instead of waiting for a reminder in the form of a notice that the work of construction is stopped or delayed because some little, perhaps inexpensive, part has been forgotten.

There are many other such special records, the need for which is suggested by the varying requirements of different lines of business, such as the meter records of a gas company, the policy record of an insurance company, the car record of a railroad company, the time record of any industrial concern, record of bills payable, record of bills receivable, &c., &c.

All these books so far mentioned we may roughly include in one class as auxiliary and statistical books.

We now come to a consideration of the books included in the other class—the regular or principal books of account.

These include, according to certain authorities, many books, some of which would be by other authorities included with the auxiliary or statistical class.

For the sake of simplicity, we can say that these principal books of account are the

Cash-Book,
Journal,
Ledger.

Some authorities will claim that the Cash-Book is a portion of the Ledger which is set apart from the other accounts because this account has to be kept in greater detail and hence can be kept more conveniently in a book of different design from that adapted to the convenient keeping of the other Ledger accounts. Others will claim that the Cash Account is so set apart because cash transactions should be recorded at once, whereas all other entries can be posted from the Journal and Cash Account when

most convenient; for having completed the chronological record and having kept up the cash record ready for instant reference nothing is risked by completing the Ledger record when not pressed for time. I can supply another reason; namely, that as it is desirable to have the Ledger records in compact form, if the *details* of Cash Account were included within the compass of the Ledger binding we should have either a very bulky volume or be obliged to frequently transfer all of the accounts to a new Ledger because the space taken to record the many cash transactions *item by item* had filled all the spare leaves; whereas by keeping Cash Account in a book by itself only that part of the Ledger has to be often renewed.

But, reason as we may, it is found desirable to have a separate book in which to fully record in chronological order all transactions in which cash has changed hands.

I prefer to treat the Cash-Book as a separate book and then summarize in the Ledger proper, under the heading Cash Account, all the transactions which are given in detail in the Cash-Book.

This is done by "posting" from the credit (or creditor) side of the Cash-Book the total footings in one amount to the credit side of Cash Account in the Ledger, and the total footings of the debit (or debtor) side of the Cash-Book to the debit side of Cash Account in the Ledger.

This makes the Ledger complete in itself, and a balance can be struck by taking off the balances of all the accounts in the Ledger without having to go to another book—the Cash-Book—to obtain the Dr. or Cr. balance of Cash Account to include with the other Ledger accounts.

As this requires only the additional posting from the Cash-Book to the Ledger of two more items per month—namely, the total Dr. footing and the total Cr. footing—consuming say one-half of a minute a month, or six minutes a year, I can find no valid argument to oppose to the course I here recommend.

Here you see at once, we are discussing variations in the methods employed to put in practice the same principles. Therefore it is not a vital point and authorities can safely disagree.

The Journal is a book in which transactions are recorded in chronological order with regard to both sides of the transaction and such explanation is included as will make the entry itself completely self-explanatory or will furnish such definite references to other books of record, naming the book and page, as will furnish a completely self-explanatory record of the entries carried (posted) from the Journal into the Ledger.

Some authorities would amend this statement by saying:—"The Journal is a book in which *all* transactions are recorded, &c." That is, some claim that all transactions should be journalized, including all cash items which are completely explained in the chronological record contained in the Cash-Book.

I prefer to use the Journal only for such entries as are not completely set out for posting into the Ledger in some other book which we include in our list of principal books of account.

The Ledger is the book in which all the entries covering all transactions are stored up in convenient form for future reference. It is the book in which all the original entries gathered from the Cash-Book, the Journal and other books which may be employed, as later to be explained, are entered under their respective account-titles and in the proper columns; viz., Dr. or Cr.

The Ledger, therefore, shows the final summing up of all business transactions and to it we refer to learn the Dr. or Cr. balance of any account, personal or impersonal.

Those of you who have had some experience in bookkeeping may be ready to ask why I have not included in my list of principal books of account, the Day-Book, Sales-Book, Invoice-Book, Petty Cash-Book, &c.

The Day-Book is intended to receive in chronological order the primary record of all transactions, including purchases and sales. Where the transactions are so numerous as to call for it as a matter of convenience, the sales are recorded in a separate Sales-Book and the purchases are recorded in a separate Invoice-Book.

But all of this *can* be done in the Journal, and hence these books can be considered as sections of the Journal.

The Petty Cash-Book is a book in which for greater con-

venience the small cash payments are recorded in chronological order, and later carried into the general Cash-Book in one entry, say at the end of the month.

So the principal books of account boil down to the Cash-Book, the Journal and the Ledger; and according to English authorities the Cash-Book is merged in the Ledger, so then we have only the Journal and Ledger.

I will now show a Journal, a Cash-Book and a Ledger in their simplest forms and include a few simple entries to show how these books work together.

JOURNAL.

(A Single Page.)

1

1904.			Dr.		Cr.	
Nov.	15	Merchandise, Dr. to Jno. Smith. 100 bbls. flour @ $4.50.	450	00	450	00
	17	Henry Herbert, Dr. to Merchandise. 100 bbls. flour @ $5.	500	00	500	00

LEDGER.

(The Dr. and Cr. items of same account are on the one page.)

Dr. EXPENSE. 3 Cr.

1904.					1904.				
Dec.	16	To cash.	2	16 50					

Dr. MERCHANDISE. 6 Cr.

1904.					1904.				
Nov.	15	To Journal.	1	450 00	Nov.	17	By Journal.	1	500 00

Dr. JOHN SMITH. 14 Cr.

1904.					1904.				
Dec.	10	To cash.	2	450 00	Nov.	15	By Journal.	1	450 00

Dr. HENRY HERBERT. 25 Cr.

1904.					1904.				
Nov.	17	To Journal.	1	500 00	Dec.	12	By cash.	2	500 00

CASH

		2 Dr.						
Dec.	12	To Henry Herbert.	100 bbls. flour.	25			500	00

In the Journal the entries are made in chronological order. The Dr. and Cr. amounts are shown on the same page. In the form shown the two columns for Dr. and Cr. are side by side at the right of the page, the Dr. column, however, to the left of the Cr. column, thus conforming to the arbitrary rule that Dr. items shall go to the left and Cr. items to the right. The titles of the accounts appear in the main space in the centre, the date in the columns at the left.

In the Cash-Book the entries are made in chronological order, the Dr. items on one page and the Cr. items on the opposite page to the right. In the column between the descriptive matter and the columns for dollars and cents are placed the numbers of the pages in the Ledger on which are shown the accounts to which the cash items have been posted. For instance, Henry Herbert's account is supposed to be on page 25 of the Ledger.

In the Ledger the entries are in chronological order *as far as each account is concerned,* but the several accounts are placed in the book as found to be most convenient. The entries are scattered through the book, following the titles of accounts. Here the Dr. and Cr. items are on a single page but, unlike the Journal, the page is divided vertically through the centre, the left half being devoted to the Dr. items and the right half to the Cr. items.

These books, especially the Cash-Book and the Journal, are ruled in different ways to meet the special wants of the business concerned or the individual opinions of the bookkeeper or accountant in charge. For instance, in the Journal sometimes the

BOOK.

		1904.					2 Cr.	
Dec.	10	By Jno. Smith	100 bbls. flour.	14			450	00
	16	" Expense acct.	Webster & Co., stationery	3			16	50

Dr. dollars-and-cents columns are on the left side of the page, the Cr. columns on the right side, and the space for descriptive matter in between.

Again, Cash and other books are frequently ruled with extra dollars-and-cents columns to receive the entries for certain accounts, leaving the one column as before for miscellaneous items. For instance, there might be on each side of the Cash-Book an extra dollars-and-cents column for Merchandise Account, for the reason that a large part of all the entries passing through the Cash-Book were on account of Merchandise. Then these extra columns would be headed "Merchandise Account" and the other columns "General" or "Miscellaneous." Then the total footings of the merchandise columns could be carried into the General Ledger in one Dr. item and one Cr. item at the end of the month, making a saving in labor, more or less important according to the volume of business involved.

But the principle remains the same.

Coming back to the examples I have given, let us trace the entries through the several books.

In the Journal is recorded first the purchase and receipt from John Smith of 100 barrels of flour. We debit the impersonal or speculative account, Merchandise, and we credit John Smith with $450.

Then we record the sale of 100 barrels of flour to Henry Herbert at $5 per barrel. We debit Herbert's account and credit Merchandise Account with $500. Through Merchandise Account

we wish to keep track of the losses and gains from the purchase and sale of merchandise; so for all merchandise purchased we debit the account and for all merchandise sold we credit the account. If at the end of a certain time we wish to ascertain the result of our trading in merchandise, we deduct the total of the debit items from the total of the credit items and the remainder is the gross profit from our trading in merchandise. If the total of the Dr. items exceeds the total of the Cr. items, it is shown that the trading has resulted in a loss.

We credit John Smith with $450 because he has delivered to us $450 worth of flour. We debit Herbert with $500, because we have delivered to him $500 worth of flour.

Coming now to the Cash-Book, on December 10th we pay Smith for the flour received from him, so we credit Cash with having paid him and this entry also implies a debit to Smith.

On December 12th Herbert pays us for the 100 barrels of flour sold to him and charged on the Journal. This $500 is Dr. to Cash because Cash receives the money, and by implication this Dr. entry to Cash makes a Cr. entry to Herbert.

On December 16th we pay out $16.50 for stationery and we debit this to Expense Account, to which account we expect to charge miscellaneous items of expense during the year, so that we may have at the end of the year a summary of the cost of all the expense items included in this account according to our predetermined classification.

Now coming to the Ledger:

We "post" the entries from the Journal and the Cash-Book into the proper accounts in the Ledger.

As I have already explained, the entries in the Journal are complete. That is, the Dr. and the Cr. side of each transaction is shown; each amount is shown twice, once in the Dr. column and once in the Cr. column. So in posting into the Ledger we post from the Dr. column of the Journal into the Dr. column of the proper account in the Ledger and from the Cr. column of the Journal into the Cr. column of the proper account in the Ledger.

But when we post from the Cash-Book into the Ledger we have to remember that what is to the Dr. of Cash is to the Cr. of

Herbert, and that what is to the Cr. of Cash is to the Dr. of Smith and to the Dr. of Expense Account.

So in posting these items from Cash-Book into Ledger we post from the left or Dr. side of Cash to the right or Cr. side of the Ledger; and from the right or Cr. side of Cash to the left or Dr. side of the Ledger.

Then, if we summarize in the Ledger the Cash Account as shown in detail in the Cash-Book, as I have recommended, at the end of the month we post the total Dr. footings of Cash-Book into Cash Account in the Ledger on the Dr. side, and the total Cr. footings of Cash-Book into the Cash Account in Ledger on the Cr. side. There is no reversal in the posting in this case, because Cash Account in the Ledger is simply a condensed form of Cash Account as shown in the Cash-Book.

If, according to the older practice, a practice still maintained by many, we journalized all Cash items, the entries I have shown in the Cash-Book would be as follows:

JOURNAL.

1904.			Dr.		Cr.	
Dec.	10	Jno. Smith, Dr. to Cash. Payment in full for 100 bbls. flour.	450	00	450	00
	12	Cash Dr. to Henry Herbert. Received in full for 100 bbls. flour.	500	00	500	00
	16	Expense acct., Dr. to Cash. P'd to Webster & Co. for bill of stationery	16	50	16	50

In this case both sides of each transaction are shown. In the case of the first entry, we not only show the debit of $450 to Smith, but we show just as explicitly the credit of $450 to Cash. As the entry is made as a basis for recording two sides of the transaction under the proper headings in the Ledger, it is apparent that we must "post" these entries, Dr. and Cr., into the Ledger as they are shown in the Journal.

But now if we omit the journalizing of Cash, and enter each transaction at once in Cash Account in the Cash-Book, we must remember that that entry only records one side of the transac-

tion and we must "post" the entry into the Ledger in the account involved on the other side of this Cash transaction.

So in the case of the John Smith entry as first shown in the Cash-Book, we must post that cash credit entry as a Dr. entry in the John Smith account, just as much as if both sides of the transaction had been covered by a Journal entry.

In the Journal I have written the entries thus:

John Smith Dr.	450.00	
to Cash		450.00

This would be just as correct and self-explanatory if written:

John Smith	450.00	
Cash		450.00

"Dr." and "to" can be safely omitted because the Dr. and Cr. columns fully indicate that Smith's account is debited and Cash Account is credited.

Also in the Cash-Book and Ledger on the Dr. side I have made the entries:

To Henry Herbert, *To* Cash, and *To* Journal;

and on the Cr. side:

By John Smith, *By* Expense Account, *By* Journal and *By* Cash.

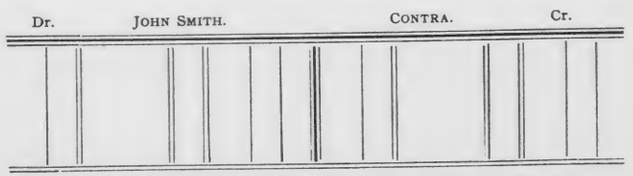
In the John Smith Account "To Cash" signifies that *so far as that one transaction is concerned*, John Smith is debtor to Cash Account or the Cashier for money paid by Cash to John Smith.

In the Cash Account this same transaction is recorded "By John Smith"—which signifies that Cash Account or the Cashier is entitled to take credit "by" (or for) the amount paid to Smith.

But this is all clearly shown without the use of the words "to" and "by" if the double-entry system of bookkeeping is understood.

Therefore, while this use of the words "to" and "by" is in conformity with bookkeeping traditions, it is not obligatory.

The older practice in writing the headings for Ledger Accounts, still followed generally in Europe and much less frequently here, is as follows:



signifying that entries on the left are to the debit of John Smith while those to the right are opposed or against these debits and therefore to his credit.

The practice in the United States is becoming more and more general, I believe, to simply write over the centre of the account, "John Smith," omitting not only the word "contra," but also "Dr." and "Cr." as surplusage.

It must now be fully apparent that for every debit item carried into the Ledger there must be a like credit item; and for every credit item a like debit item. In this connection we must recollect that if we do not have a Cash Account in the Ledger we must consider the Cash-Book as part of the Ledger.

Considering the Ledger accounts which I have shown, we find the following Dr. and Cr. balances:

	Dr.	Cr.
Expense Account	16.50	
Merchandise Account		50.00
Cash Account—as shown by Cash-Book	33.50	
Showing the Drs. and Crs. balance	50.00	50.00

What is true in the case of these few simple entries would be true no matter how many and how complicated the entries were provided the work was correctly performed.

It will be noticed that in this Ledger balance I have taken no notice of Smith's account and Herbert's account because in each case the Dr. and Cr. items balanced or cancelled each other.

Analyzing the figures taken from the Ledger, we find that by trading in Merchandise we have made a gross profit of $50, from which we must deduct $16.50 for expenses, leaving $33.50 net profit, and this net profit we find as a cash asset in Cash Account.

tion and we must "post" the entry into the Ledger in the account involved on the other side of this Cash transaction.

So in the case of the John Smith entry as first shown in the Cash-Book, we must post that cash credit entry as a Dr. entry in the John Smith account, just as much as if both sides of the transaction had been covered by a Journal entry.

In the Journal I have written the entries thus:

John Smith Dr.	450.00	
to Cash		450.00

This would be just as correct and self-explanatory if written:

John Smith	450.00	
Cash		450.00

"Dr." and "to" can be safely omitted because the Dr. and Cr. columns fully indicate that Smith's account is debited and Cash Account is credited.

Also in the Cash-Book and Ledger on the Dr. side I have made the entries:

To Henry Herbert, *To* Cash, and *To* Journal;

and on the Cr. side:

By John Smith, *By* Expense Account, *By* Journal and *By* Cash.

In the John Smith Account "To Cash" signifies that *so far as that one transaction is concerned,* John Smith is debtor to Cash Account or the Cashier for money paid by Cash to John Smith.

In the Cash Account this same transaction is recorded "By John Smith"—which signifies that Cash Account or the Cashier is entitled to take credit "by" (or for) the amount paid to Smith.

But this is all clearly shown without the use of the words "to" and "by" if the double-entry system of bookkeeping is understood.

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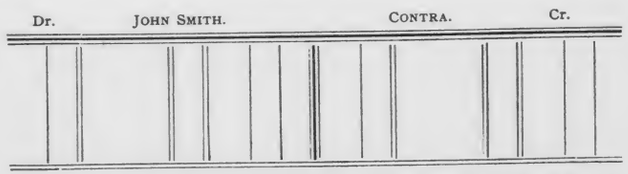


signifying that entries on the left are to the debit of John Smith while those to the right are opposed or against these debits and therefore to his credit.

The practice in the United States is becoming more and more general, I believe, to simply write over the centre of the account, "John Smith," omitting not only the word "contra," but also "Dr." and "Cr." as surplusage.

It must now be fully apparent that for every debit item carried into the Ledger there must be a like credit item; and for every credit item a like debit item. In this connection we must recollect that if we do not have a Cash Account in the Ledger we must consider the Cash-Book as part of the Ledger.

Considering the Ledger accounts which I have shown, we find the following Dr. and Cr. balances:

	Dr.	Cr.
Expense Account	16.50	
Merchandise Account		50.00
Cash Account—as shown by Cash-Book	33.50	
Showing the Drs. and Crs. balance	50.00	50.00

What is true in the case of these few simple entries would be true no matter how many and how complicated the entries were provided the work was correctly performed.

It will be noticed that in this Ledger balance I have taken no notice of Smith's account and Herbert's account because in each case the Dr. and Cr. items balanced or cancelled each other.

Analyzing the figures taken from the Ledger, we find that by trading in Merchandise we have made a gross profit of $50, from which we must deduct $16.50 for expenses, leaving $33.50 net profit, and this net profit we find as a cash asset in Cash Account.

ACCOUNTING CONTINUED—GENERAL NOTES.

NOVEMBER, 1904.

Many authors of textbooks on bookkeeping and accounting make little effort to explain principles. Some set out certain definite rules to be memorized and expect that the students when they have to decide some question as to principle or method can select the right rule and properly apply it. This may work satisfactorily for bookkeepers, but certainly it cannot work satisfactorily for accountants, and especially would it be unsatisfactory in the case of men like yourselves, who will be called upon in this connection to deal with principles only.

Here it is to be noted that some of the very best textbooks as to methods so neglect to teach principles. But it is quite possible that some of you who might be concerned in assisting the bookkeeping department of some concern to record fully and correctly the results of an industrial business might find it of distinct advantage to refer to some of these authorities who are sometimes particularly strong on good shortcuts for the reduction of clerical labor. If the engineer-student had previously obtained a fairly good grasp of the principles, he might, working in co-operation with a good bookkeeper, be of great assistance in utilizing some of these shortcut methods.

Many authorities place much stress upon the divisions of accounts. Anyone studying the subject of classification of accounts and their main divisions will soon understand that these divisions can be made from several different standpoints. One of the divisions that can be found in some of the English textbooks is as follows:

REAL ACCOUNTS, dealing with actual property;

PERSONAL ACCOUNTS, showing the record of transactions between the owner and the various persons with whom he has business transactions;

NOMINAL ACCOUNTS, dealing with various forms of income and expenditure.

As this division is studied, it will be seen that there is often no essential difference between real and personal accounts. They merge into each other.

Another division is, PERSONAL, REAL AND IMAGINARY ACCOUNTS; the first two covering the same ground as shown in the case first cited, and the last taking account of stock and expense accounts.

As we come to analyze a trial balance and the Journal entries for closing the books, we will see that Stock Account, while having to do with the losses and gains of the year, also has to do with the question of assets and liabilities.

Another division is:

SPECULATIVE ACCOUNTS, having to do with merchandise, real estate, interest, expense, &c.,

and

NON-SPECULATIVE ACCOUNTS, having to do with items from which neither loss nor gain is to be directly expected, such as cash, bills-payable, bills-receivable, personal accounts, &c.

Here again a modification can be brought in through the fact that a loss is developed by bills-receivable not being paid at their full face value.

Another division is, PERSONAL AND IMPERSONAL ACCOUNTS.

Personal accounts are, as before explained, the accounts with individuals, firms and companies with which we do business and in connection with these accounts we must, in making our entries, always consider the other party to the account.

The impersonal accounts are such as Merchandise, Expense, Repairs, Wages, Salaries, &c., varying with the scheme of classification. In these accounts we have to consider only the several relationships between different features of our business. In the case of personal accounts, cross entries, that is, the debiting of one account and the crediting of another, cannot be made without taking into account the rights of the other party to the transaction. In the case of impersonal accounts, such cross entries can be made without doing an injustice to anyone except to the owner

or owners of the business, though, of course, the result might be even in this case to falsify the accounts.

Apart from any arbitrary division of accounts, the main thing is to continually bear in mind that, no matter what the name of the account may be, we must carefully discriminate between the treatment of our accounts with respect to assets and liabilities, and with respect to income and expense. This I shall endeavor to point out in connection with the items of depreciation. If depreciation is not cared for from earnings—and I am referring to depreciation of plant, depreciation of manufactured stock, stock in course of manufacture, or material to be manufactured into stock—we are involving our asset accounts and drawing upon our capital.

In this connection I will state a rule which it will be well for you to memorize and, having memorized it, to test it by the application of principles as we go forward in our work, and especially when we come to the analysis of a ledger balance sheet.

Items on the

Left side of Ledger:—

a. If the amount will eventually be received, it is an *asset.*

b. If the amount will not be received, it is a *loss.*

Right side of Ledger:—

a. If the amount will eventually have to be paid, it is a *liability.*

b. If it will not have to be paid, it is a *gain.*

I am not giving you this rule with the idea that it shall be memorized to the exclusion of the principles involved, but rather to assist you in applying the principles of accounting and so making you competent to read a balance sheet without the assistance of any memorized rule.

The other day I was asked by a member of this class, what I meant by a debit balance or a credit balance.

The fact that such a question was asked emphasizes the necessity for some instruction in accounting, if only to enable the engineer to understand the language of business. It is not

only necessary that the engineer should understand this language, but he should understand something of the many dialects, or certainly he should know that there are many different dialects; that is, many different forms of expression though based upon the one mother tongue.

A debtor, or debit, balance is the amount by which the Dr. side of the account exceeds the Cr. side.

A creditor, or credit, balance is the amount by which the Cr. side of the account exceeds the Dr. side.

A question recently asked and many similar experiences indicate that the relation of Cash to the business in which Cash is concerned is at times very puzzling.

Let us consider for the moment that the owner does nothing for himself and consequently assume that when a person pays in a sum of money to the owner's business it is not he (the owner) who receives it, but his cashier or his Cash Account that receives it for him and is accordingly his debtor for the amount received. The cashier has received the money on behalf of his employer and therefore is liable for it and must subsequently account for it. Until he so accounts he is a debtor for the amount so received.

If, then, the cashier is made debtor for each amount which he receives on behalf of his employer, we must make him *as far as any one transaction is concerned* the employer's creditor when he pays out money on behalf of the employer.

If we balance up between the Dr. items and the Cr. items we may find that the cashier is still debtor for a balance of cash on hand; but, nevertheless, he has been made creditor for each item of cash paid out; and it is by balancing up, or placing against each other, the Dr. and Cr. items that we learn the final result as to whether there is a Dr. or a Cr. balance. If there is a Dr. balance of cash it indicates that the cashier being debtor, there is a balance of cash in his hands for account of the owner. If there is a Cr. balance to Cash Account, it indicates that there is a deficit—there is no cash on hand, but there is money owing to the cashier.

This relationship of Cash to the business should be turned

over in the mind and viewed from different standpoints, and especially you should get into the habit of looking at the transactions as shown on the books of account from the standpoint of the outsider; that is, you should develop the capacity of correctly interpreting a statement of account whether you look at it from the standpoint of the owner or the standpoint of some one doing business with the owner; you should acquire the habit of seeing the two sides of each transaction.

The other day a question was asked as to what I meant by my reference to the use of blanks and whether certain monthly reports had been made up on regular printed forms prepared for that specific purpose.

A scheme of accounting which has to do with a business of any magnitude should provide for a minimum of clerical labor by including printed forms or blanks to meet all cases which are continually recurring. Manifestly, it would be absurd to have a printed form or blank for cases coming up only at long intervals, but it would be equally as absurd to write out in each case all the words and figures of a communication or of a report if from time to time such a communication was varied only in certain parts.

There are many advantages in such a system of printed forms or blanks; I will mention four which at once occur to me.

1. It lightens the labors of the one writing the communication or report.

2. It serves to remind the writer what information is required. This is particularly important, because the memory cannot be safely relied upon in the press of business.

3. It presents the information to the one for whom it is intended according to a uniform style and practice, greatly reducing his labors, especially by facilitating calculations and comparisons.

4. It simplifies and facilitates the operations of filing; that is, the storing away in definite form for future reference—one of the most important features of the recording department of a large and complicated business.

Much saving of labor and greatly increased efficiency can be obtained through a well-developed, common-sense system of printed forms.

I can point out a somewhat different direction in which blank forms can be used to very great advantage, insuring greatly increased efficiency in the actual performance of duty and finally leaving the records in much more complete form than could otherwise have been provided for. I will refer to only one case, which, no doubt, is more or less familiar to all of you but which can be used very well here as an illustration.

Railroads have to do with an immense amount of detail in their several departments, and especially in the operating department. Blank forms, in almost infinite variety, are employed to facilitate prompt and accurate action and the maintenance of correct records. It can be seen that especially in the case of instructions to be sent over the wire it is important that they should be conveyed to the one to be directed with absolute accuracy and at the minimum cost in time. The instructions must be condensed as far as possible without sacrificing clearness and explicitness.

Take the case, for instance, of a wreck. The conductor must get the news to the proper officials without delay. If he had to write out every word required to make a correct and comprehensive report he would have to write many minutes longer than when using a blank form and there would thus be an unnecessary delay in conveying the information to the officials from whom instructions and assistance are required. Furthermore, at such a time of mental stress, his memory could not be relied upon, for we find that memory cannot be depended upon even at times when the conditions are normal.

To meet this a blank is used by the railroads, which has spaces for every item of information which past experience has shown it is necessary should be dispatched on such occasions. Opposite each of these spaces are certain words which ask a direct question and in each case the question is indicated by a cypher, either a letter or a number. The conductor of the train which has been involved in the accident proceeds to the nearest telegraph station on his line and calls for this blank form, "Acci-

dent Report by Telegraph." He fills in the blank spaces as required and, as I have said, he is thus reminded of each item of information which the operating department will require of him. As soon as the blank is filled up, the operator calls for the operator at the other end of the line and tells him to provide himself with "Accident Report by Telegraph" blank. The operator at the scene of the accident then gives the cypher in each case, followed by the information which the conductor has filled in the space, and so he goes down through the whole blank and promptly conveys to the operating department the information required to meet the emergency which has arisen. The receiving operator, as soon as he receives the cypher, turns to that space in his blank and fills in all that comes over the wire until the next cypher is signalled.

It can be readily seen that not only does this give the opportunity for the operating department to promptly and efficiently do everything possible to correct the troubles brought about by the accident, but a complete record is furnished which can be referred to with confidence in case of lawsuits or other troubles.

Furthermore there are other advantages, because such a system, carried out completely, must lead to great saving in the expenditures for wages, and also must lead to reductions in the cost of plant: for, take the case just referred to; a single wire would be capable of conveying a much greater volume of information when so much of that information is reduced to cypher form. Of course, if the use of telegraphic blank forms were confined to reporting wrecks, this item of investment and maintenance would be unimportant, because the number of accident reports is limited. However, an immense number of blanks are in constant use for other purposes which require the use of the telegraph, namely the reporting of the movements of cars in trains and their presence at stations, reports of conductors from distant points showing the make-up of their trains, reports of freight and coal at various places along the line, &c., &c. Such reports as these constitute an important percentage of the telegraphing each day.

But there is a danger in this connection; namely, the danger

of going to extremes—a danger to be always feared and avoided. System, over-developed, becomes red tape and that perhaps is to be avoided almost as much as the lack of system. A proper appreciation of the value of performance should go ahead of appreciatcn of the value of properly recording the performance. The keeping of the records should not over-shadow the development and maintenance of a proper system for the carrying on of the business. The greatest efficiency in performance and the most explicit and convenient forms of record are of great importance and should go hand in hand. The keeping of a reasonably complete and detailed set of records helps to increase the profits from a given volume of business and also helps to increase the volume of business. Unless by the records results can be accurately analyzed it is difficult and often impossible to eliminate weaknesses and uneconomical items of management. It is not sufficient to know that your business is profitable as a whole; you should know what are the results, step by step.

In connection with our tremendous development in industrial lines there is springing up a new business; namely, that of the industrial engineer, or engineer-accountant, or economy engineer; for these and other titles have been used. Two or three of our graduates are experts in this line, and we may well mention Mr. Frederick E. Taylor, Mr. Henry L. Gantt and Mr. E. R. Douglas. Men to be competent in this line must be well qualified in industrial matters, especially shop practice, and also qualified as accountants. They must be capable of analyzing the records and accounts of a business so that they can detect uneconomical steps in shop practice and management; and, having detected such weaknesses, they must be competent to devise methods for improvement. Sometimes these methods of improvement have to do with changes in the system of management or of control, and sometimes they have to do actually with changes in processes of construction. It will, therefore, be seen that the field is a very wide one and calls for ability of a high order, re-enforced by wide experience.

Any system of shop cost records should furnish the means for comparing, month by month, every item of cost. If such an

inspection of the records shows that during a certain month a certain item of cost has been increased, at once it is suggested that an investigation should be instituted to learn the cause or causes of this increase. It is only by such continual exercise of intelligence and vigilance that the costs of a large business can be kept within competitive limits.

Apart from this question of comparison, there is constantly an immense waste of time and nerve force through the lack of well-arranged records, this deficiency making it necessary to "dig out" information which ought to be at hand complete and ready for use as required. Not only is time thus wasted, but busy men have their burdens immensely increased by the pressure resting upon them through duties unperformed. Often the hardest part of a task is getting the work started, and this because we have not at hand certain data which we have previously developed but which is not now in form for ready reference.

In this connection I may well refer to the advantages of the card system. There are concerns now that make a specialty of working up to order card index schemes for all special cases, supplying not only the cards but also the furniture required to make the scheme complete. I can remember the time when a man who adopted the card system had to work up his own scheme, have his own material manufactured and then secure a result far inferior to what can now be secured at small expense through the services of experts in that line.

If a card system is adopted for the filing of data collected outside the office, some systematic scheme must be developed whereby these notes will be from time to time passed into the hands of those responsible for the maintenance of the card scheme. One good arrangement which does away with the necessity of doing the work twice is to keep in your pocket a bunch of cards, of convenient size, keeping the blank cards in one side of a wallet, say, and those which have been written on in the other side. As it becomes necessary to make a memorandum of data obtained, it can be filled in on one of these cards and the card then put in with those ready for filing. From time to time the cards written on can be passed over to the filing clerk and another

supply of blank cards placed in the wallet. This arrangement can be supplemented by having envelopes of exactly the same *outside* dimensions as the cards so that when a newspaper clipping or the like is secured it can be filed in one of these envelopes, and as the envelopes are of the same outside dimensions as the cards, the pack can be conveniently manipulated.

I shall now turn to the consideration of depreciation because in treating that part of my subject I shall necessarily have to refer to the principles of accounting. Having covered, as far as time will permit, the subject of depreciation, I shall return to accounting and especially the analysis of a balance sheet.

REPAIRS AND DEPRECIATION.

NOVEMBER, 1904.

Because I have found that many engineer-students find it difficult to understand why depreciation of plant must be made good out of the profits of a business, I shall not hesitate to frequently repeat myself in the following notes.

Unless depreciation of plant, and depreciation of any property in which capital is invested, is treated as a charge against the gross profits, the capital must necessarily be impaired.

Let us take a very simple case.

Suppose a young man without capital is desirous of engaging in a business requiring capital—say trading in pumps. A friend offers to supply the capital for an agreed upon interest on his money. The young man buys 100 pumps and commences to make sales. As the pumps are paid for, the money is turned in to the young man's cash account, and as demands are made upon his private purse, he meets these demands with this money—the total proceeds of his sales.

The stock of pumps he does not renew.

It certainly requires no argument in this case to show that he has spent the profits from the sale of the pumps and also the principal intrusted to him by his friend.

Following this line of thought, it can be seen that each time a pump is sold not only must another pump be bought to replace the one sold, or enough money be set aside for this purpose when the proper time comes, but, before claiming any profit on the transaction, there must also be set aside out of the proceeds from the sale enough to pay the pro rata of the year's expenses and of the year's interest to be paid to his friend for the use of capital.

If 100 pumps, alike in character and in value, are sold during the year, then from the proceeds of each pump must be

deducted one one-hundredth of the year's expense, one one-hundredth of the year's interest and the original cost of the pump before a profit can be claimed.

This is such a self-evident proposition that it hardly seems worth while to bring it to the attention of a class of intelligent men. But it is because this self-evident proposition is lost sight of in accounting that so many failures occur in the industrial field; for it must be apparent after a moment's thought that it is just as necessary for the manufacturer to maintain, out of his profits, the full value of his plant as covered by capital investment as it is for the tradesman to keep up his stock in trade.

You are all, probably, familiar with the fact that in properly conducted concerns engaged in trade—large and small—before they make up their statements to cover the results of the year's business, they have to take stock, as it is called; that is, they have to go through their stores and warehouses, carefully list everything that is on hand, determine whether it has depreciated in value, and so finally arrive at as correct as possible an estimate of the *present* value of the stock in hand. If that present value proves to be less than the value as shown by the books of account, the difference must be charged up as one of the items of loss for the year.

This all goes to show the constant care and vigilance that must be exercised by the accountant or bookkeeper to insure the complete separation of the capital, or investment, accounts from the income, or expense, accounts. And in the case of an industrial undertaking this matter should not be left to the accountant or bookkeeper alone, but the responsibility should be fully assumed by the manager, who probably would be (under modern conditions) an engineer. The necessity for the manager not delegating this authority and this responsibility to others exists through the fact that neither the accountant nor the bookkeeper is necessarily qualified to decide many of the points involved in the distinction between extensions or betterments and repairs or maintenance of plant. Frequently a nice discrimination is here necessary. In deciding all such questions the conservative manager should give the benefit of the doubt to his

investment accounts and charge all debatable items to repairs or maintenance.

Let us consider in some detail how a plant depreciates.

This depreciation can be divided into three classes:

1. Certain minor parts of the plant break or become so inefficient that they have to be repaired or replaced by new parts. These repairs and replacements are paid for out of income and should be charged up as part of the expenses of the year in which they occur unless they are made part of an inclusive yearly charge estimated to cover all repairs, renewals and depreciation.

2. Certain parts, greater in value, break down or become inefficient and they have to be repaired or replaced by new parts. These repairs or replacements may be paid for out of income and then charged up as part of the expenses of the year in which they occur, or the cost may be distributed over a number of years according to the number of years the repaired or replaced part has done duty; or they can be included in a general item as referred to in connection with No. 1.

3. But even when all the repairs and replacements as covered in No. 1 and No. 2 are made, the plant as a whole is not maintained at its original value, even though it may be thus from time to time restored as far as possible to its original efficiency. In spite of these efforts to maintain the plant at par value, it will gradually age and there is beside the liability of its becoming obsolete.

In spite of repairs and replacements, the plant as a whole will finally need to be renewed. It is not to be understood by this that the whole plant will necessarily have to be rebuilt at one time. But whether the plant is renewed as a whole, or part by part, the renewals must be made and cannot be obviated by current repairs or renewals.

In a general way we speak of this final renewal of plant, made necessary by depreciation or aging, as if the plant were to be rebuilt as a whole at some time in the future, but such would be an extraordinary case. One part of the plant we can reasonably expect to last perhaps for fifteen years; another part, twenty years; another part, twenty-five years, and so on. Often well constructed masonry buildings (part of the plant) will last so many years that the chance of their becoming obsolete has to be considered rather than their actual wearing out or aging.

A little thought must show that if we are to keep intact that part of our capital invested in plant, we must pay from each year's earnings for the repairs and replacements mentioned under No. 1; and we must pay for the more serious repairs and replacements mentioned under No. 2 either out of the year's earnings in which they are made or we must set aside from each year's earnings an amount which we estimate will be sufficient to cover the year's share of these deferred repairs; and finally we must set aside out of each year's earnings an amount sufficient to compensate for the final depreciation described under No. 3.

Generally the current repairs and replacements (No. 1) can be made a direct charge against the year's earnings without disturbing the uniformity of net profits which is so desirable.

As all the items included in these three classes of expenditure on account of maintenance of plant are to be provided for out of earnings, the yearly net profits will be caused to vary widely if all the payments made for repairs, replacements and final renewal of plant have to be paid for out of the earnings of any one year in which these payments are made. It is at once evident that the final renewal of plant (depreciation) cannot be paid out of the earnings of any one year.

Then just so far as is necessary to prevent wide fluctuations in our operating charges we must provide in advance for part at least of these expenditures by regularly setting aside part of our earnings to meet the accrued and accruing liability due to depreciation of plant. If we decide to meet that part of the loss from depreciation which shows itself in the necessity for repairs and minor replacements from time to time by including the cost of these items in the expenses or losses of the year in which they are made, we still have no provision for paying the cost of the deferred repairs or renewals nor for the final renewals or depreciation; and these last two are just as real liabilities as the current repairs.

It may be well to stop here a moment to speak more directly on this subject of accruing liability, something of vital importance in connection with the correct keeping of accounts and the preparation of correct statements of Loss and Gain.

Let us suppose that a manufacturing concern has to pay a large royalty on some patented invention and that by agreement the payments on this royalty are to be made semi-annually. Suppose there is prepared a complete statement of the results of each month's operations—that is, a monthly statement of Loss and Gain. If in the statements made for the months in between the months in which the royalty settlements are made, there is no mention made of these royalties, it is apparent that the profits for two months of each year will be called upon to meet a large item of cost which should be spread evenly or pro rata over the twelve months of the year. Thus it will be made to appear that during certain ten months of the year the operating cost has been much lower than during the other two months. It is quite possible that a most superficial examination of these monthly statements would show the reason for this wide variation in the *rate* of profit, but some calculation on the side would still be required to show what would be the facts in connection with an exact and fair comparison. The obvious comment on such imperfect monthly statements is—"Why not make them complete and self-explanatory in themselves?" This means, then, that every statement of Loss and Gain should include not only the actual payments made during the period covered by the report but also every item of accrued and accruing liability. It makes no difference whether the actual payment has been made or not, if the fiscal period covered by the report is, under the conditions of the business, required to meet a certain liability, that liability must be included in the expense, cost or loss items of the period.

And the same is true with regard to the income items. In the royalty case cited, considering the other party to the transaction, the receipts are not applicable to the month alone in which they are received but they are applicable to each month of the year.

Now what is important with regard to the monthly statements of Loss and Gain is much more important with regard to half-yearly and yearly statements, because on these latter we base our calculations as to the division of profits—the paying of dividends. If a considerable item of accrued liability is omitted from our yearly statement of Loss and Gain, to that extent our profits are shown greater than they are in fact, and if the total profit for the year is paid out in dividends, to that extent the dividend is paid from capital or surplus, but certainly not from the earnings of the period.

From this it is to be seen that in all statements of Loss and Gain, and especially those upon which dividends are declared, all accrued losses or liabilities and accrued gains or assets should be included.

Following this point a little farther, if these accrued debits and credits are to appear in the statements of Loss and Gain, they should first appear in the regular books of account. I specifically make this point, unnecessary as it may appear to some of you, because too frequently I have found that a statement of Loss and Gain was first made from the regular books of account and then by notes or comments, written or verbal or both, the actual facts were developed. I recently discovered in the case of a manufacturing concern in which I am pecuniarily interested that the statements of Loss and Gain prepared from the books of account were *completely* misleading and that it was necessary to supplement these statements of account by information on the side, part of it recorded in letter-books, part of it in pocket memoranda and part not recorded at all. Special discounts had been allowed but not regularly recorded; special settlements of disputed accounts had been agreed upon, but pending the actual settlement, no record of the agreements had been made on the books of account; certain depreciation in manufactured goods had been definitely acknowledged, but these goods were still carried on the books of account at their full original cost; and so on. This is not an extraordinary case. The man responsible as General Manager was not an inexperienced man; on the contrary, he was a man of wide experience, well versed in the principles of accounting as applied to industrial and commercial affairs, and a man

who had before always successfully managed the concerns intrusted to his care.

His fault originated in three causes:

1. The commercial and shop *details* of this business were quite different from those of the businesses in which he had previously been interested.

2. He did not surround himself with efficient assistants, and as a result he was over-worked to the point of being threatened with complete nervous collapse. He was obliged to devote so much of his time to certain details in the shop and the counting-room, that certain other details were completely neglected and there was no time left to maintain a general and comprehensive view of the field.

3. As the results from the business failed to completely verify his somewhat rosy predictions, he did not try very hard to keep in view and on record his accrued and accruing liabilities. *And this without any deliberate intention to deceive.* It would have been difficult for him in any case to have maintained at all times a completely accurate record of the modifications of his transactions. Pressed upon as he was by the conditions I have named, and being anxious not to unnecessarily alarm those who had invested in his concern, naturally the reports failed to show the facts.

And let me warn you that this case I have cited is only one of many which have come under my personal observation and that you must be prepared to meet such conditions in the ordinary run of business. Those of you, especially, who may be called upon to report upon the value of industrial properties, must appreciate that no final estimate can be made until there is complete accord between the engineering or technical side of the report and the accounting or commercial side of the report; and in order to be sure that there is this accord the engineer or technical expert must at least be able to understand, without the assistance of an interpreter, the accounting portion of the report. I have been called upon to investigate many a case worse than the one cited, and, I am sorry to say that in some few cases it was quite apparent that

the faulty statements of Loss and Gain were the result of deliberate and studied effort to deceive.

Coming back to the matter of accrued and accruing losses and gains, let me give you one example on each side which are almost always to be found involved in the business of industrial concerns—taxes and insurance.

Taxes are frequently paid after or at the end of the time covered by the assessment.

Insurance is paid in advance.

Then in the first case we have an accru*ing* liability and in the second case we have an accru*ed* asset.

Each month we should show in our monthly Loss and Gain statement, the amount we estimate will have to be paid for taxes as applicable to that month. And until the facts are actually obtainable we must estimate as accurately as possible.

And the total of the monthly charges for unpaid taxes so far accrued must appear on the books as an accrued liability.

In the case of insurance, the advance payment will be charged to "Advance Insurance Premiums," or some account with equivalent title, and, month by month, the month's pro rata will be charged to the expenses of the month, and credited to "Advance Insurance Premiums Account."

The original debit of the total premium to "Advance Insurance Premiums" will show that amount as an asset—we have invested a certain amount of money in insurance, the insurance company yet having to render service therefor.

As each month we charge up (debit) the proper expense account with the month's pro rata of this insurance premium (that is, take it out of the investment class of debit items, into the operating cost, expense or loss class of debit items), and *credit* it to "Advance Insurance Premiums," we reduce, as we should, the amount to the debit of "Advance Insurance Premiums"; that is, we reduce the value of this item of our assets. The insurance company has now rendered service for this month's premium paid in advance and hence at first an asset, and the month's pro rata of total premium has become one of the month's items of expense.

I have thought this to be a good place to step aside from considering the subject of depreciation, to consider the more general subject of accrued and accruing liabilities and assets. I have purposely introduced some of the steps in accounting involved in the recording of some of these items which have to do with the future either as to payment or liability.

I quite appreciate that it may be difficult for many of you to follow the steps shown in this case of insurance premiums. Let me encourage you to make a real effort to comprehend the points involved in these entries. Success will mean that you have made a long step toward an understanding of the principles of accounting and double-entry bookkeeping.

Coming back now to the subject of maintenance of plant, including repairs and depreciation (or if we prefer, current renewals, deferred renewals and final renewals) we find that for each division of time covered by a statement of loss and gain there should be included in that statement a pro rata charge or pro rata charges to include the several items of maintenance, so that each such division of time will be called upon to carry its share of the burden but no more.

A moment's thought makes it apparent that even in the case of current repairs and replacements included in Class No. 1, each item should be spread uniformly over the time through which the part repaired or replaced has done service: that is, each of these items should have been treated in advance as an accruing liability. This could be done and sometimes is done, by setting aside each year out of earnings, a certain estimated amount to meet this accruing liability as part of one inclusive maintenance charge, as later to be explained in connection with Class No. 2, deferred renewals, and Class No. 3, final renewals or depreciation.

But as a rule the scheme for providing for deferred renewals (based, as it is, largely on estimate) is much simplified if we pay each year out of the year's earnings the ordinary current repairs and replacements, leaving the deferred renewals and final renewals (depreciation) only to be treated as accruing liabilities.

The ordinary current repairs can generally be charged direct

against the year's business without causing any radical fluctuation in rate of profits, because, if we eliminate the items to be included in the other two classes, Nos. 1 and 2, the direct charges made on account of current repairs will probably be found not to vary greatly in yearly totals.

Coming now to the items included in Class No. 2, the case is quite different. These repairs and renewals are much more serious in character. They are of more occasional occurrence and to charge them up to the expenses of the one year in which they occur would at times seriously detract from the accuracy of the several yearly statements of Loss and Gain.

That is, the year in which some extraordinary repair or renewal was paid for would be called upon in the statement of that year's Loss and Gain to bear the total cost while the other years which had had the benefit of the service of this part of the plant would have been relieved of all cost therefor.

To cover these items, then, it is better to set aside from each year's earnings an amount which we estimate will be sufficient to meet these deferred renewals when they come to be made.

Coming to Class 3, depreciation or final renewal of plant, you are now prepared to appreciate the necessity of providing for this accruing liability by setting aside for the purpose a certain per cent. of each year's earnings.

To cover this item the first step is to estimate the probable life of each part of the plant, taking into consideration the class and character of plant, its design and construction, the way in which it is operated, and especially whether it is over-worked or not, whether it is kept in good repair, and whether the cost thereof is charged year by year against the profits. In arriving at an estimate of ultimate life of plant we therefore have to take into consideration questions as to other features of our practice in accounting as well as questions in connection with the design, construction, operation and maintenance of the plant itself.

Each part of the plant should be examined, and taking advantage of our own experience and that of others and bearing in mind the special conditions already referred to, we should

arrive at an estimate of the final length of life of each of these parts. Here is required the trained judgment of the engineer or technically trained manager.

For each of these parts we must set aside each year such an amount that with the accumulations of compound interest, there will be sufficient to pay for the renewal of this part at the end of its estimated length of life.

It now becomes necessary to decide what rate of compound interest can safely be depended upon through the term of redemption. Here comes in the trained judgment of the banker.

Next we have to calculate what amount, compounded yearly at the rate of interest we have assumed to be procurable for the full term, will produce at the end of that term (n years) the value of the part of plant under consideration. When the amount to be set aside for each part of the plant is determined, we can sum up the several amounts so obtained, and dividing this total yearly charge by the total cost of the plant we arrive at an average per cent. of the total cost of plant, which can conveniently be used in calculating each year the *total* amount to be set aside against depreciation. As additions are made to the plant, the depreciation of these parts must also be provided for. If these additions to plant do not disturb the balance of our life table, we simply have to take this average per cent. on the increased cost; otherwise we have to establish a new life table for the parts added, using the original average per cent. on the original cost of plant. These two average per cents. could be combined to give us a final average per cent. *up to date*, again to be amended as necessity dictated.

Finally we have to so place the record on the books of account that the yearly statements of Loss and Gain will show the actual facts and that there will be a continual warning on the Ledger and balance sheets against diverting from the prescribed purpose these amounts so set aside each year.

To arrive at the per cent. of original cost necessary to cover depreciation it is the custom with many to accept without question the dictum of text books and especially of books on accounting. It may be of value to consult such works, but if so it must be

understood that no general rules can be established for application in all cases. The life of a plant must necessarily depend upon many special and local conditions and especially it must depend upon how the plant was originally built and how it is being operated and maintained.

Consider two extreme cases, one where plants are well designed, well constructed and, while being operated within their capacity, are carefully kept in repair, and the other where they are poorly designed, poorly constructed and, while being operated beyond their capacity, are not kept in repair. That the depreciation in the value of plant will be insignificant in the first case as compared with the second case, and that therefore general life tables cannot be applied without detailed examination of the plant in each case, must be apparent.

Here then, as I have said, must be brought into play the trained judgment of the manager who, preferably, has obtained his training first in the school of technology and later in the school of experience.

Each part of the plant should be carefully investigated and classified according to its probable length of life. The total value of the plant should be split up among these several classes. A working life having been assigned to each of these classes, it should be assumed that at the end of each of these life periods the parts of the plant which have been included in this class must be renewed.

I have shown that deferred renewals or extraordinary repairs, as we may regard them (Class No. 2), should be provided for by building up a fund by yearly payments from earnings.

This accruing liability can be provided for by including it with the accruing liability for final renewals or depreciation (Class No. 3) now under consideration.

Then in making up our final life table we assume that certain minor parts have been replaced and paid for under the head of current renewals or repairs (Class No. 1) out of each year's profits, but that the deferred renewals (Class No. 2), and the final renewals—depreciation—(Class No. 3) can be grouped together

so that the one yearly deduction from earnings shall cover all *accruing* liability for maintenance of plant.

While it is true that a plant as a whole will depreciate in value in spite of all that is done to repair breakages, renew inefficient parts, and the like, it is possible that some portions of the plant may be fully kept up to original value by current repairs and renewals.

To take a very obvious case—the life table established to cover depreciation might omit certain of the parts which are of short life, it being part of the general scheme to renew these parts out of current earnings. As has been already explained, this might in some cases lead to an uneven distribution of the cost of repairs, but it should be recognized that if such a plan is followed it will materially alter the life table as applied to accruing liabilities for maintenance.

A case in point might be the mains of a gas company, which are usually composed of cast iron pipe. In many soils cast iron pipe will not deteriorate rapidly, even if it will deteriorate at all from the outside. These cast iron pipes will take on a scale of oxide of iron which will protect them from further oxidation. The inside of the pipe is not subject to oxidation, but to the contrary the inner surfaces are rather protected by the hydro-carbons in the gas. I have myself carefully examined pipes which have been down fifty years and, as far as the quality of the iron was concerned, there seemed to be no impairment. Of course, it is quite possible that disturbances of the bed on which the pipes lie, due to the digging up of the streets for sewers and the like, might greatly destroy the value of the pipes; but this in the case of a well-conducted company might rather indicate that there was no necessity for including a yearly charge for depreciation because these troubles would have been cared for from time to time and the repairs would have been paid for out of the current earnings. In such a case it is quite possible that at the end of five, ten, fifteen, twenty or twenty-five years the main system in general might be in more effective condition for economical operation—that is, the delivery of gas without leakage—than when first laid. The weaknesses, as they

made themselves evident, might have been corrected and the cost paid for out of current earnings. This serves again to point out that in making up a life table it is necessary to examine not only the conditions as to the plant itself, but the conditions as to the accounting methods followed.

It may be well to here point out that the case of cast iron pipe as used for gas is very different from the case of the same pipe used for water. In the latter case it is the practice to coat the pipes inside and out with tar and I have found that some engineers are of the opinion that the coating is necessary or an advantage even on the outside of the pipe. The real advantage, however, is that it prevents oxidation of the inside of the pipe, for the water passing through carries with it more or less oxygen from the air; oxidation results; the pipe is reduced in thickness, because the scale as formed is carried forward by the push of the water, thus depreciating the pipe and developing a continuing trouble in connection with the operation of the plant, due to the scale being deposited in valve seats and the like.

So in the case of water mains we are warranted in expecting less depreciation if they were coated before they were laid. But with gas mains the case would be just the opposite, for the tar coating is a distinct disadvantage. Not only is it not needed for protection, as explained, but the tar deposited on the outside of the spigot ends and the inside of the bells is attacked and dissolved by the hydrocarbons of the gas and so these two tar films which are included in the caulked joint are carried away and leakage results. So definite is this fault that experienced gas engineers only accept tar-coated cast iron pipe when they find it impossible to obtain the uncoated pipe to meet an immediate demand, and in these cases they are careful to burn off all the tar from the spigots and bells.

The conditions in regard to service pipes (which are almost always of wrought iron) are quite different. In most soils, unless the pipe is thoroughly protected by some applied coating, the wrought iron rapidly oxidizes and the pipe steadily deteriorates. Here again, however, we have to take into account the methods locally pursued for the maintenance of this

part of the plant and the methods pursued in the accounting department. If, year by year, the services are renewed as they are found to be defective and if, learning from experience, the management makes its renewals with coated pipe instead of the ordinary black pipe and the cost therefor is charged up as one of the items of the year's expenses, as far as this item is concerned the plant may appreciate in value rather than depreciate.

Again, certain parts of the plant under investigation might be found to need renewal say, on the average, every five years, and it might be that some of these parts would need renewal one year and some another, so that the cost of renewal would be distributed not too unevenly over the five years life period. If now these renewals are charged up to the repairs of the year in which they are made, they should not be considered in the estimate upon which the depreciation life table is made up. Here, then, is an item which because of its short life, might appear to be a most important element of depreciation but which upon further consideration we see is properly disregarded because it has already been cared for in repairs or current renewals.

This all goes to show that it is the evidence of ignorance or inexperience for anyone to stand off at a distance, without examining the plant and system of accounting, and attempt to apply some general rules to determine the reduction in plant value due to depreciation in a special case.

The first thing is to have a clear conception of the premises upon which our life estimate is based and then to place on record all the facts in this connection that we may not later amend our figures—perhaps under pressure to make a favorable statement of earnings—through misapprehension as to the original basis of our estimate. All the records in our books of account should be self-explanatory and so sufficient for the guidance of those who are to come after us, and especially so in the case under consideration where the man who establishes the original basis for the yearly charge on account of depreciation is likely to be in his grave before the expiration of the life period.

We will assume that we have a plant which has cost $500,000 and that we determine that:

Part "A" will be good for ten years and its cost is	$25,000
Part "B" will be good for fifteen years and its cost is	50,000
Part "C" will be good for twenty-five years and its cost is	100,000
Part "D" will be good for thirty-five years and its cost is	150,000
Part "E" will be good for fifty years and its cost is	175,000
Total	$500,000

Now, so far, we have been using the trained judgment of the practical operator of the plant. Now we have a very different proposition. How shall we determine the amount of money to be set aside to take care of this depreciation; in other words, to renew these several parts of the plant as they become useless or inefficient?

We will assume that we will provide for this case by actually taking out of our profits each year a certain amount of cash and setting it aside to accumulate at compound interest.

We will now first have to estimate the rate of interest that can safely be reckoned on *through a series of years* (viz., through the life of the plant) and here we require the trained judgment of the banker.

Having assumed a rate of interest, we still have to determine the amount which, at this rate of interest, compounded yearly, will give us the amount required. It may be the interest could be compounded half-yearly, but my assumption makes the proposition simpler, while the principle is the same. This is in the line of work performed by the insurance actuary, but, of course, there is no difficulty in the engineer learning for himself every step of the process.

If we set aside each year for n years a constant number of dollars to accumulate at compound interest, we have a geometrical progression. Let me remind you that quantities are in geometrical progression when they increase or decrease by a constant factor.

If A is the first term, r the common factor or ratio, n the number of terms and S the sum of n terms in the geometrical progression, we have

$$S = A \frac{r^n - 1}{r - 1}.$$

In our problem r, the ratio or factor, is 1 plus the fraction indicated by the rate of interest assumed as obtainable throughout the life of the plant. Let us assume the rate of 4 per cent., then $r = 1.04$; that is, the constant amounts previously set aside will each year be multiplied by 1.04.

In the equation just given, A is spoken of as the first term of the geometrical progression; in our case A will be the last term, because the last payment of A will not have accumulated any interest, whereas the first payment of A which has been accumulating 4 per cent. compound interest will have been multiplied at the end of the second year by 1.04, the next year the principal A + the interest will have been multiplied by 1.04 and so on to the end of life of plant. That is, each of the constant annual payments from earnings will have accumulated at 4 per cent. compound interest. Thus at the end of the life of the plant we shall have a series of annual payments each with its interest accumulation, constituting a geometrical progression which *decreases* by a constant factor or ratio, which ratio for 4 per cent. compound interest will be 1.04. Considering the yearly payments (A) *separately*, the first payment, A, will be made at the end of the first year; at the end of the second year this will have increased by interest to Ar; at the end of the third year to Ar^2; at the end of the fourth year to Ar^3, and at the end of the nth year (the life of the plant) to Ar^{n-1}. Therefore, the second payment, at the end of n years (with one year's interest less) will have increased to Ar^{n-2}; the third payment to Ar^{n-3}; the third payment from the end to Ar^2; the next to the end to Ar; and the last will be A, for it will have had no opportunity to accumulate any interest.

Then instead of an increasing geometrical progression,

$$A + Ar + Ar^2 + Ar^3 + \ldots\ldots\ldots + Ar^{n-3} + Ar^{n-2} + Ar^{n-1},$$

we will have

$$Ar^{n-1} + Ar^{n-2} + Ar^{n-3} + \ldots\ldots\ldots + Ar^3 + Ar^2 + Ar + A.$$

This only changes the order of the terms, and in no way modifies the calculation.

In our problem, having the values of S, r and n, we have to solve for A, the amount to be set aside each year.

If for S we use the total value of plant for each class of plant, n would be the assumed life for that class. But we can make the equation of more general application by solving for the *per cent.* of value of plant required to be set aside, and this can be done by taking S as 100 or 1 instead of the full value of the portion of plant under consideration.

In either case, as I have said, A is our unknown quantity. The equation

$$S = \frac{A(r^n - 1)}{r - 1}$$

gives us

$$A = S \frac{r - 1}{r^n - 1}.$$

With this equation let us determine the amount to be set aside each year at 4 per cent. compound interest to redeem the value of Part "A" of plant, viz., $25,000, in 10 years. Then

$$A = 25{,}000 \frac{1.04 - 1}{1.04^{10} - 1}.$$

It is not necessary to employ logarithms to obtain the 10th power of 1.04, as you will probably have at hand Kent's Pocketbook, and on page 14 you will find a compound interest table as generally to be found in arithmetic textbooks. These tables can be used to determine the value of n as they give the results from compounding $1 at various rates of interest through a series of years, which means that these are tables of powers. For instance, at 4 per cent., the first year shows 1.04 (= 1 × 1.04); sec-

ond year, 1.0816 (= 1.04 × 1.04); third year, 1.124864 (= 1.0816 × 1.04); and ten years, 1.480244. Then

$$A = 25{,}000\ \frac{1.04 - 1}{1.480244 - 1} = \frac{1{,}000}{0.480244} = 2082.$$

Then to redeem $25,000 at the end of 10 years we must invest annually $2,082, if the interest to be obtained is 4 per cent. compounded annually.

But our determination will be capable of more general application if we take S as 1 or 100 and so determine how much we must set aside each year at 4 per cent. compound interest to redeem $1 or $100. In the first of these two cases our answer will be a fraction which, multiplied into the amount to be redeemed, will give the amount to be set aside each year. In the second case, we get as an answer the per cent. of the amount to be redeemed to be set aside each year which, multiplied into this amount to be redeemed, and divided by 100, gives the annual payment.

To make sure that the use of the equation given is thoroughly understood and for reasons to follow, let us solve for A, using 1 for the value of S and then using 100.

$$A = S\ \frac{r - 1}{r^n - 1} = 1\ \frac{1.04 - 1}{1.04^{10} - 1} = \frac{.04}{.480244} = .08329.$$

25,000 × .08329 = $2,082, the amount to be set aside each year as previously determined in solving direct for the $25,000, the total amount to be redeemed

Again,

$$A = S\ \frac{r - 1}{r^n - 1} = 100\ \frac{1.04 - 1}{1.04^{10} - 1} = 8.329,$$

or 8.329 per cent. of the amount to be redeemed.

(25,000 × 8.329) ÷ 100 = $2,082, as before determined.

An additional reason for my taking the trouble to carry out in detail the several ways of using our equation to solve the problem in hand is because I have frequently noticed the troubles occasioned by lack of uniformity in the methods followed to indicate per cent. A not uncommon error, even among bookkeepers, is the filling in of the items in a column calling for rates per cent. with fractions, when a fraction is not called for. For instance, a column will perhaps be headed "Per cent." and in that column may appear an item .02, which is intended to mean 2 %, but which, in view of the heading really means two-hundredths of one per cent. Those who know better when they stop long enough to think forget that "two per hundred" can be written

2 *per cent.* (= 2%), or .02, or $\frac{2}{100}$, but not as .02 *per cent.* or $\frac{2}{100}$ *per cent.*

But particularly I have gone into this detail because I now wish to refer you to certain tables which can be used directly for the several values of A. I wish you to understand how these tables are derived and I also wish you to understand why the two tables to which I shall specifically refer can be both used to obtain the same result, except for some few minor inaccuracies in one of them.

In Kent's Handbook, page 16, you will find a table showing the annuity required to redeem *$1,000* for one, two, three, four, &c. and certain other years up to 100, at several rates of interest, compounded annually. In using this table we find the figure we are looking for at the intersection of the vertical column which indicates the rate of interest and the horizontal column which indicates the life of the part of plant we are considering. When this figure is found, it is for the amount required each year invested at 4 per cent. compound interest to redeem $1,000, so if we prefer to state the result in per cent., we move the decimal point one place to the left.

In Matheson's "Depreciation of Factories" (second edition) we find on pages 67 and 68, "Table 3; Sinking Fund; Annual Investment to Produce One Pound in a Term of Years."

Notice how self-explanatory is this title.

This is a more extended form of the same table as given in Kent, except that it is calculated for the redemption of £1 instead of $1,000. In Matheson's table the results are stated as fractions and therefore can be used direct as multipliers. The results are

stated as fractions indicating per cent. without the use of the words *per cent.* or the sign %.

At my request, the calculations in these tables were checked by a member of the Class of 1904 and he found that Kent's table is correct and Matheson's correct except in the two following cases:

Vertical column 3 %, horizontal column 3 years, Matheson gives .3225; this should be .3236.

Vertical column 4 %, and horizontal column 15 years, Matheson gives .0492; this should be .04994.

Let us now calculate out our plant life table, using both the Kent and Matheson tables.

1	2	3	4	5	6	7	8
Part of Plant.	Est-mated Life in Years.	Value of Plant in DOLLARS.	Kent's Table. — Requir'd to Redeem $1,000.	Matheson's Table. — Requir'd to Redeem £1.	Direct Multiplier Derived From Kent's Table or Taken Direct From Matheson's.	Per Cent. Derived From Either Table.	Amount to Be Set Aside Each Year to Cover Depreciation (Redemption) of Each Part of Plant. — DOLLARS.
A	10	25,000	83.29	.08329	.08329	8.329	2,082.25
B	15	50,000	49.94	.04994	.04994	4.994	2,497.00
C	25	100,000	24.01	.02401	.02401	2.401	2,401.00
D	35	150,000	13.58	.01358	.01358	1.358	2,037.00
E	50	175,000	6.55	.00655	.00655	0.655	1,146.25
		$500,000					$10,163.50

It should be quite unnecessary to point out that the amount in column 8 can be obtained by multiplying the number of thousands as shown in column 3 by the figure shown in column 4; or by multiplying the full amount shown in column 3 by the figures shown in both columns 5 and 6; or by multiplying the number of hundreds as shown in column 3 by the figure shown in column 7.

If we have not the Kent, or Matheson or equivalent table

by us, then each of the amounts in column 8 can be calculated from

$$A = S\frac{r-1}{r^n-1}.$$

In this case tables of logarithms would be required, or the powers of 1.04 would have to be calculated.

Suppose we prefer the result in the form shown in column 7; namely, per cent.

For A we have, as before shown, $A = 100\frac{1.04-1}{1.04^{10}-1} = 8.329.$

For B we have, as before shown, $A = 100\frac{1.04-1}{1.04^{15}-1} = \frac{4.}{.800944} = 4.994.$

For C we have, as before shown, $A = 100\frac{1.04-1}{1.04^{25}-1} = \frac{4.}{1.6658} = 2.401.$

For D we have, as before shown, $A = 100\frac{1.04-1}{1.04^{35}-1} = \frac{4.}{2.9460} = 1.358.$

For E we have, as before shown, $A = 100\frac{1.04-1}{1.04^{50}-1} = \frac{4.}{6.1064} = 0.655.$

agreeing with the figures as obtained from the Kent and Matheson tables.

It is well to here draw attention to a mistake which is sometimes made in estimating the average life of a plant. Take the case we have already considered and the calculation might be as follows:

Years.		Value of Parts in Dollars.		
10	×	25,000	=	250,000
15	×	50,000	=	750,000
25	×	100,000	=	2,500,000
35	×	150,000	=	5,250,000
50	×	175,000	=	8,750,000
				17,500,000

17,500,000 ÷ 500,000 = 35 years average life.

But if the average life of the plant were as long as 35 years, we find by referring to the Kent or Matheson tables that it would require only 1.358 % of the total value of the plant (viz.,

$6,790), set aside each year at 4 %, compound interest, to rebuild the plant at the end of its life.

But taking each part in detail we have found that to *renew each part* as its life expires will require an annual payment to the sinking fund of $10,163.50, which is 10,163.50 ÷ 500,000 = 2.03 % of the total value of the plant.

By referring to Matheson's Sinking Fund table already referred to we find that 2.03 is almost exactly the per cent. required to redeem the cost of the plant in twenty-eight years.

So we see the "average life" method of calculation is absolutely misleading.

To emphasize this point, let us make some calculations to learn the result of assuming an average life of 35 years and so setting aside each year only $6,790, = 1.358 % of total value of plant, instead of $10,163.50, = 2.03 % of total value of plant.

At the end of the first ten years we will have accumulated

$$S = A\frac{r^n - 1}{r - 1} = 6790\,\frac{1.04^{10} - 1}{1.04 - 1} = 6790\,\frac{.4302}{.04} = \$81{,}513.95.$$

Withdrawing $25,000 required to renew Part "A," we have left 81,513.95 — 25,000 = 56,513.95, say $56,514. This will accumulate by the end of the next 5 years (15 years in all), when Part "B" has to be provided for, 56,514 × 1.2166 (= $1. compounded 5 years at 4 %) = $68,755, and the additional yearly payments to sinking fund will accumulate to

$$S = 6790\,\frac{1.04^5 - 1}{1.04 - 1} = 6790\,\frac{1.2166 - 1}{1.04 - 1} = 36{,}768.$$

The total accumulations will be 68,755 + 36,768 = $105,523. Withdrawing the $50,000 required to renew Part "B," we have a balance left, 105,523 — 50,000 = $55,523.

At the end of the next 5 years (20 years in all) we have to provide for a second renewal of Part "A."

During this time the balance of $55,523 will accumulate to (55,523 × 1.2166 =) $67,549; and during this time the additional annual payments will accumulate to $36,768, as before calculated. The total accumulations will be 67,549 + 36,768 = $104,317.

Withdrawing the $25,000 to again renew Part "A," we have a balance left 104,317 — 25,000 = $79,317.

At the end of the next 5 years (25 years in all) we have to provide for the renewal of Part "C"—$100,000.

During this time the $79,317 will accumulate to (79,317 × 1.2166 =) $96,497; and during this time the additional annual payments will accumulate to $36,768, as before calculated. The total accumulations will be 96,497 + 36,768 = $133,265.

Withdrawing the $100,000 to renew Part "C," we have a balance left of $33,265.

At the end of the next 5 years (30 years in all) we have to renew Part "A" for the third time, $25,000, and Part "B" for the second time, $50,000, making $75,000 in all.

During this time the balance of $33,265 will accumulate to (33,265 × 1.2166 =) $40,470; and the additional annual payments will amount to $36,768, making the total accumulations $77,238.

Withdrawing $75,000 for renewing Part "A" for the third time and Part "B" for the second time, we have a balance left of only (77,238 — 75,000 =) $2,238.

At the end of the next 5 years (35 years in all) we have to renew Part "D" for the first time, requiring $150,000; and during this time the balance amounting to $2,238 will accumulate to (2,238 × 1.2166 =) $2,722.

Adding the accumulations of the annual payments for 5 years, $36,768, we have a total accumulation of (2,722 + 36,378 =) $39,490.

So after renewing Part "D," $150,000, we are in debt (150,000 — 39,490 =) $110,510.

Thus at the end of the 35 years, which was assumed as the average life of plant, we are in debt for depreciation renewals $110,510, and falling behind all the time, as will be seen.

At the end of the next 5 years (40 years in all) we have to renew Part "A" for the fourth time, requiring $25,000.

The debt of $110,510 will during this time increase to (110,510 × 1.2166 =) $134,446. The total to be provided for is,

therefore, (134,446 + 25,000 =) $159,446. Against this we have only the yearly accumulations, amounting to $36,768. So now our debt is increased to (159,446 — 36,768 =) $122,678.

At the end of the next 5 years (45 years in all) Part "B" has to be renewed for the third time, requiring $50,000.

By this time our debt will be increased to (122,678 × 1.2166 =) $149,250. The total to be provided for is, therefore (149,250 + 50,000 =) $199,250. Against this we have only the yearly accumulations, amounting to $36,768. So now our debt is increased to (199,250 — 36,768 =) $162,482.

At the end of the next 5 years (50 years in all) we have to provide for the fifth renewal of Part "A," ($25,000), the second renewal of Part "C" ($100,000), and the first renewal of Part "E" ($175,000) ; $300,000 in all.

The debt of $162,482 during this time increases to (162,482 × 1.2166 =) $197,675. The total to be provided is, therefore, (300,000 + 197,675 =) $497,675. Against this we have only $36,768, the yearly accumulations for the five years; which, deducted, leaves a debt of $460,907.

Thus it is seen that by the "average life" scheme which we have just tested, at the end of 50 years, in spite of having laid aside $6,790 each year at 4 % compound interest, we are actually in debt for renewals we have been obliged to make to the extent of $460,907, the original value of plant being only $500,000.

It is well here to bear in mind to avoid possible confusion of thought that this demonstration does not depend in principle upon the actual assumptions in the life table, as the same life periods have been assumed in each case.

In the scheme which I have suggested, requiring in this case an annual payment to Depreciation Sinking Fund of $10,163, each part is treated separately and, at the end of the life of each part, a sufficient amount has accumulated for renewal and again this part of annual payment to Sinking Fund goes on accumulating to pay for the next renewal of the part concerned.

While, for convenience of statement and to facilitate convenient comparison with other cases of depreciation cost, we may calculate out the average per cent. of total value of plant to be laid aside each year,—finding it in this case 2.03 %—still we must not forget that this total is made up of absolutely distinct annual redemption payments, each to take care of its own parts of the plant and to renew those parts as *often* as they wear out.

As the subject of depreciation is of commanding importance, and as the results obtained from the two systems of estimating which I have shown, differ so widely, and as it is difficult to understand why the difference at the end of 50 years should amount to almost the original total value of plant, I shall make a further analysis of the results from these two systems.

If $6,790 (the amount called for by "average life" system) were paid into Sinking Fund each year and accumulated *undisturbed* for 50 years, at 4 % compound interest, the total value of Sinking Fund would then be:

$$S = A\frac{r^n - 1}{r - 1} = 6790\,\frac{1.04^{50} - 1}{1.04 - 1} = 6790\,\frac{7.1064 - 1}{1.04 - 1} = \$1{,}036{,}561.$$

If $10,163 (the amount called for by separate life system) were treated in the same way, at the end of fifty years the total would be:

$$S = 10{,}163\,\frac{7.1064 - 1}{1.04 - 1} = \$1{,}551{,}485.$$

But, by the life table assumed in both cases, we see that there would be certain withdrawals from each of these sinking funds. In the following table I show these withdrawals and I also show the number of years in each case remaining before the expiration of the 50 years, during which the amounts so withdrawn would have gone on accumulating at 4 % compound interest if they had

been left undisturbed, and the total accumulation thereby in each case.

1	2	3	4	5	6
At End of Years.	Parts to be Renewed. Class.	Amount Required for Renewals. —$—	Unexpired Part of 50 Year Term. Years.	Value of $1. Compounded at 4 % for Years Given.	Amounts Accumulated at End of 50 Years. Principal and Interest. Col. 3 x Col. 5. —$—
10.....	A	25,000	40	$1.04^{40} = 4.8009$	120,022.50
15.....	B	50,000	35	$1.04^{35} = 3.9460$	197,300.00
20.....	A	25,000	30	$1.04^{30} = 3.2434$	81,085.00
25.....	C	100,000	25	$1.04^{25} = 2.6658$	266,580.00
30.....	A and B	75,000	20	$1.04^{20} = 2.1911$	164,332.50
35.....	D	150,000	15	$1.04^{15} = 1.8009$	270,135.00
40.....	A	25,000	10	$1.04^{10} = 1.4802$	37,005.00
45.....	B	50,000	5	$1.04^{5} = 1.2166$	60,830.00
50.....	A, C & E	300,000	0	$1.04^{0} = 1.$	300,000.00
		$800,000			$1,497,290.00

Referring to the "separate life" system, we have seen that if $10,163 were paid into Sinking Fund yearly and not disturbed the total accumulations would amount to..... $1,551,485

If now we deduct the amounts withdrawn with accumulated interest as shown in last table..... 1,497,290

we find we should have in the Sinking Fund at the end of the 50 years,..... $54,195

If our calculations are correct, this should equal the accrued liability for depreciation at the end of the 50 years. Classes A, C and E were renewed at the end of the 50 years, so we have to consider only Classes B and D.

B was renewed for the third time at 45 years, and so there has accrued a 5-years' liability on that part of plant.

D was renewed for the first time at 35 years, and so there has accrued a 15-years' liability on that part of plant.

By the original life table it was shown that Part B required an annual payment to Sinking Fund of $2,497, and Part D, $2,037.

Then there should remain in the Sinking Fund at the end of 50 years, after paying for all renewals up to and including that year:

B— $S = 2497 \frac{1.04^5 - 1}{1.04 - 1} = 2497 \frac{1.2166 - 1}{1.04 - 1} =$ $13,521

D— $S = 2037 \frac{1.04^{15} - 1}{1.04 - 1} = 2037 \frac{1.8009 - 1}{1.04 - 1} =$ 40,791

$54,312

which practically agrees with the amount remaining in the Sinking Fund after all the withdrawals for renewals just shown, amounting to $54,195. The difference is accounted for by the fractional multipliers not being carried out far enough.

Coming now to the "average life" figures, we have seen that the total in Sinking Fund at the end of 50 years, if the fund had been undisturbed, would have been $1,036,561.

But by the table of withdrawals we found that these amounts with interest were..... $1,497,290.

This shows a *deficit* of..... $460,729, which is in practical agreement with the amount of shortage first shown by detailed analysis, which was..... $460,907.

If to the deficit just shown we add the accrued liability as just shown in the case of the "separate life" scheme, we have a total deficit of (460,729 + 54,312) $515,041.

If our calculations have been correct, this should be equal to the difference between the totals of the undisturbed accumulations under the two systems:

Separate life system,..... $1,551,485

Average life system,..... 1,036,561

Difference—being total deficit by average life plan,... $514,924, which is in practical agreement with the total deficit just shown.

From what has been shown about providing for depreciation it can be seen how a sinking fund could be established to extinguish a debt—say to liquidate a bonded indebtedness—in a given num-

ber of years. Such an arrangement is not infrequently a feature of the trust agreement under which bonds are issued. The extinction or reduction of a debt under such a sinking fund scheme is known as amortization, a term more frequently heard in Great Britain than here.

I have followed through these two schemes for calculating a depreciation sinking fund because I have found that too often there is a lack of definite opinions on this subject among those charged with responsiblity in connection therewith; and that, further, where definite opinions are held they are not infrequently based upon an insufficient knowledge of the elements entering into the problem.

I have thought also, that for young men who may be placed in positions where questions as to the relative merits of investments may come up for solution, before they have had the opportunity to learn in the school of experience, it might be of some advantage to give them a concrete example of the results to be obtained from the straight investment of money at compound interest, even at as conservative a rate as that of 4 per cent. This lesson may even be of value to those who have had actual experience in the field of business, and especially with "quick rich" schemes of varying degrees of contained fallacy.

Some of you will no doubt be called in to examine the scientific and technical details of marvelous inventions which form the basis for some of these "quick rich" schemes.

Unless guarded against, the inclination too often exhibited is to remember the few instances of such schemes which have quickly brought large pecuniary returns, and to forget the hundreds and thousands of cases where there has been either no pecuniary return, or only a moderate return as the result of long-continued and costly efforts to develop into practical and commercial success some hidden element of intrinsic merit.

In such cases which come up for decision, it is well to keep always in mind two things:

1. You cannot get out of anything more than it contains; in spite of any invention, the conservation of energy principle will be maintained.

2. The pecuniary returns to be obtained *from a business not yet established* must compete with the returns to be obtained by safely investing at compound interest:—that is, leaving the interest as well as the principal to accumulate interest.

In connection with the second point we may well recollect that the majority of fortunes have been built up by frugality and the incessant operation of the accumulative process of compound interest.

Those of us who have invested moderate amounts from time to time even in schemes which had intrinsic merit but which were as yet undeveloped and therefore obliged to pass through a period of no-dividends, are surprised to find that by safely investing these amounts at a moderate rate of interest and allowing them to compound, we would have greatly bettered our fortunes and saved ourselves from much needless worry.

If we have a business which as a result of our particular skill and ability as specialists is bringing us in a good return and leaving us a surplus after meeting personal expenses, we will do well to invest that surplus safely and allow compound interest to do the rest.

Above all things, we should avoid being led astray by the opinion that because we have succeeded in the line of work for which we have through years of work in the college and school of experience trained ourselves to be competent, we are also necessarily competent in other lines, which up to that time we have never followed.

Many a fortune that has been gained through years devoted to experience-getting in one special line of endeavor has been lost because the winner of that fortune did not correctly determine by analysis the elements entering into the cause of that success.

And the most dangerous "flyer" which can be taken is the purchase of stocks on a "margin."

In buying on a "margin" you buy perhaps ten times as much stock as you have money to pay for, the balance of the purchase price being borrowed on the security of the stock purchased. Your broker kindly arranges the loan so as to facilitate your entering into business relations with him. The market price of

your purchased stock goes down and more margin is required of you by your broker—that is, you must put up more money or have your stock sold out. The fall in price may be temporary, but unless you have the additional margin of cash you lose that already put up. Whereas, had you purchased outright,—purchased only such an amount as you could pay for in full,—the temporary fluctuations in price would not have imperiled your investment. If the stock represented a property of intrinsic merit at a fair valuation, you would only have had to hold your securities until "better times" returned.

We have just gone through a period where many fortunes were wiped out because of extensive purchases "on margin"; whereas, many other fortunes, which were tremendously cut down "on paper," have been restored wholly or in great part because the depreciated securities were held by men who had money enough to protect them until prices were restored to the normal.

I have been asked a number of times in class to draw the distinction between stock gambling and the buying of stocks for investment.

While every business venture must contain more or less of the element of speculation, stock-gambling is nothing but speculation.

If we buy merchandise with the purpose of reselling if possible at a profit, we cannot avoid the element of speculation, because the merchandise may increase or decrease in value while in our hands. In the same way, if we purchase stocks or bonds for investment, the element of speculation is necessarily involved. In purchasing for investment, eliminating as far as possible the element of speculation, *we buy only what we can pay for.*

In stock-gambling, the purchase is made by putting up a "margin" of say 10 per cent. of the market value of the stock purchased. That is, perhaps ten times as much stock is purchased as the purchaser has money to pay for, the balance being borrowed on the securities purchased.

Evidently then, the venture is based upon the ability of the purchaser to correctly estimate the chances of the market price of the security rising and falling, and in the case of the ordinary

victim, the purchaser has no control over the possible fluctuations in price. The purchaser, then, gambles on chances over which he has no control, and as he is involved to perhaps ten times the amount of the money he has put up as margin, which may be all that he owns, he is taking a risk with his savings which no man has a right to take who has others dependent on him for support.

In every panic in the stock market competencies and fortunes are wiped out because those involved cannot protect their stock transactions.

On the other hand, book losses which come to bona fide investors are frequently made good wholly or in part by the natural increase in prices which always follows a panic. The investor who is only interested in the market through securities which he owns outright can, if he has the courage, wait for the recovery which he can feel sure will follow.

It needs no argument to show that the selling of securities which one does not own—selling short—is nothing else but gambling. It is a game of chance.

Replying to another question—of course, stock exchanges are not only useful institutions, but they are a business necessity. Without the broad markets created by the facilities afforded by the stock exchange, securities would necessarily have to be sold at a sacrifice when it became necessary to promptly turn investments into ready cash, and financial operations would be limited in countless ways.

But because the stock exchange is a necessity in connection with legitimate banking does not prove that all, or even a majority, of stock exchange transactions are legitimate.

I think, then, that I am warranted in saying that if we buy securities and pay for them in full we are making a legitimate investment, and if we make ourselves liable for more than we can pay for, we are gambling.

This may all seem apart from the question of "depreciation," but the opportunity was afforded me through the illustrations of the workings of compound interest to utter a word of warning (particularly needed, I think, by the technical man), and as

I am trying to give you a general view of business conditions and methods, I have not hesitated to step for a moment into this side path.

Coming back to the subject of depreciation or deterioration of plant, let me say that the scheme I have advocated and shown in considerable detail, is not one which, as far as I know, is generally followed; certainly not in the United States.

It is much more general in Europe to set up a sinking fund to cover depreciation and also fluctuations in rates of profits so that the dividends may be maintained at a uniform rate, or at least to insure their not being reduced.

It is not only of importance that the stockholders in a company should be able to calculate in advance on the amount of income they are to receive from their investment, but it is important that the stock representing the principal shall not be allowed to unnecessarily fluctuate in selling-price. At any time some emergency may arise necessitating the sale of the stock. If the rate of dividend is allowed to fluctuate, the selling-price of the stock will be unfavorably affected.

I do not mean to say that in the United States the loss due to depreciation is neglected, but not infrequently this loss is *not accurately measured* and so it cannot be known whether the correct amount has been withdrawn from the year's profits to meet this item of loss. Necessarily, it is a problem which cannot be solved with mathematical accuracy. Necessarily, the exercise of judgment is involved; hence, if we are to be on safe ground we must depend upon a specifically trained judgment. But in any case we finally have to depend upon an estimate and this means that year by year as we gain further experience in the particular problem to be solved we should revise our scheme at every point where we find our estimate is not confirmed by accomplished fact.

In many cases, depreciation is more or less covered by the money taken from profits and reinvested in betterments and extensions of plant.

Sometimes this is done without any special effort being made to estimate the actual depreciation.

In such cases, the process is certainly a hap-hazard one.

Unless we follow systematically some method for estimating the cost of depreciation, we cannot be sure that our capital is not being impaired.

I am chiefly concerned, then, that you shall understand the necessity for this appraisal of cost of depreciation in advance, and so be prepared to take measures to pay fully for it out of earnings.

Frequently in the United States, the amounts withdrawn from profits to cover depreciation are advisedly reinvested in extensions and betterments to the plant under process of depreciation. Then we are warranted in including in our life table such a rate of interest as we feel positive that these betterments and extensions of plant will earn *for themselves.*

If the yearly return or rate of interest (r) is thus increased, the amount to be set aside each year (A) will be decreased. This scheme would necessitate the isolating of this portion of the yearly profits and reinvesting them in further extensions of plant. Thus we should have to provide for the investment in plant extensions of the several yearly depreciation payments plus the compound earnings from these extension investments. The result would be complicated and cumbersome, becoming more and more so each year.

The simpler and more usual arrangement is to allow the earnings from these extensions of plant to be merged with the other earnings. In this case, we must invest each year in plant extensions such an amount as, without assistance from interest accumulations, (or separate earnings from these plant extensions) will pay for the several parts of original plant in accordance with the life table: For instance, for a ten years life, it would require one-tenth of the cost; for a fifteen years life, one-fifteenth of the cost, and so on.

While this will require a larger yearly payment (A) to meet depreciation, the earnings from the additions to the plant (r), which will be merged with the other earnings will off-set this increase, provided that these earnings from extensions of plant do not decrease the average per cent. of earnings.

In any case, we must also provide for the depreciation of

these plant additions. This portion of the subject I shall refer to again in connection with the problems in accounting to be considered in connection with depreciation.

When the amount deducted from profits to cover depreciation is invested in additions to plant, the record in the books of account must be so kept that no warrant shall be furnished by such record for the issue of additional capital stock, on the plea that this investment represents surplus profits. It must never be forgotten that there are no surplus profits until depreciation is paid for out of earnings.

As these additions to plant are only intended to compensate for the depreciation in the value of the original plant, such additional issues would finally mean the duplication of capital stock on the one capital investment.

There is here a distinct danger which has already manifested itself in the field of United States finance, and especially in reorganization and consolidation schemes of ownership. An analysis of the accounts shows, or *appears to show*, that the properties of the concern are worth more than the face value of the issued securities—bonds and stock.

So far as securities are issued against extensions to plant paid for from that part of the earnings which were set aside, or should have been set aside, to compensate for depreciation, so far is it a "watered" issue.

On the other hand, there are cases where the extensions to plant paid for from profits far exceed the cost of depreciation or original plant, and so furnish a legitimate warrant for the issue of additional securities.

Sometimes the increased value of real estate will compensate for the decreasing value of plant due to depreciation, but it must be manifest that an assumption to this effect cannot be safely made in advance.

If after the event we find such to be the case, so much the better for us and we are that much ahead. This is one of the elements of speculation that, deplore it as we may, enter into every line of business.

Also, the value of the business as a "going concern,"—franchise rights, good-will, &c.—may so appreciate as to compensate for depreciation of plant and possibly far more.

But again, I say we cannot safely make such an assumption in advance.

In taking over a property, or group of properties, the question of past depreciation is taken care of in the purchase price. The plant may be greatly in need of repair and extension. Then the cost of repairs, renewals, extensions and improvements should be most carefully estimated and considered as a part of the purchase price. To carry on the business economically after we assume control, we must put the plant in condition for efficient operation. Having carefully estimated the cost of these improvements and added the amount to the purchase price, we must determine if we are warranted in paying the total cost so arrived at.

But it is here to be most carefully borne in mind that if we include the rehabilitation of plant as part of original cost and therefore cover this item by capital obligation, we must *at once* set up a scheme to pay for the depreciation or deterioration of the rehabilitated plant which will commence as soon as it is put into operation. It may be claimed that this depreciation does not commence at once, that the plant will improve in efficiency for a certain length of time depending upon how long it takes to "find itself." If this is to be considered, then introduce it as an element in setting up your life table; but do not delay in starting your depreciation sinking fund scheme. As in many other places, there is here danger in delay.

It is possible that the results obtained from the business in the past would show but a small rate of profit on the enlarged capital. Here we are warranted in giving some weight to a conservative estimate of the increase in profits to be derived from improved plant and *improved business management.*

It can readily be seen that this last may become a very dangerous element in the financing of schemes of reorganization and consolidation. The investing public and sometimes the bankers themselves are dependent upon the estimates of cost of

improvements and of increase in earnings furnished by the experts employed.

The subject is too large a one to be covered in this brief course on the business side of engineering, but I have said enough to show that the technical expert to be safely relied upon, first by the banker and then, through the banker, by the investing public, must be thoroughly competent, technically and commercially.

But this is not enough—he must be honest and have the *courage of his convictions.* He must be strong enough to say "no" in the face of great temptation.

We have had many a case of stocks representing these consolidation schemes declining in price almost at once after the investing public have absorbed them (sometimes before the absorptive or digestive process has been completed) through the over-estimating of the value of the business and the under-estimating of the cost of rehabilitation of plant.

See to it that none of you, either through ignorance or design, are ever responsible for so robbing the public.

Here there is resting upon you a professional responsibility as great as that resting upon the doctor and the lawyer, for remember that there are many ills worse than death that may follow in the train of wrecked fortunes.

ACCOUNTING AS APPLIED TO DEPRECIATION.

MAY, 1904.

Referring to Question 4—(*b*) and (*c*)—Paper of May 6, 1904.

I have been asked—Why should Depreciation be *charged* (= debited) to "Loss and Gain Account" (= Profit and Loss) and *credited* to Depreciation Sinking Fund Account (= Final Renewal Fund)?

In charging estimated depreciation of plant to Loss and Gain and crediting the same to Depreciation Sinking Fund, we really skip or lose sight of a number of intermediate steps.

First, think of "depreciation" as deferred repairs or deferred renewals—or better, perhaps, as final repairs or final renewals. We cannot pay for depreciation at once, as we do in the case of repairs, because the plant is not yet to be abandoned; it is not yet worn out; but we know it will wear out in time and so we must provide for its renewal at the expiration of its life, and this can only be done by taking out of our profits, year by year, such an amount as will, accumulating at compound interest (the rate of interest to be determined by the exercise of banking judgment), rebuild or renew the plant when it does finally have to be abandoned. (In fact the plant will never have to be abandoned *as a whole* and rebuilt *as a whole*, but what is true of the parts is true of the whole and for simplicity we will speak of the whole.)

It is thus seen that the money to pay for repairs or current renewals, must be taken out of income and so must the money for final renewals, that is, depreciation. This money must come out of income and be a charge ahead of profits or else it must come out of capital. It can be at once seen that if it were taken out of capital, and all the apparent profits paid out in dividends, the capital would, year by year, be impaired to the

extent of the amounts paid out of Cash for current renewals (repairs) and the accrued liability for depreciation of plant.

Hence the cost of repairs (which I shall hereafter call current renewals) and the value of depreciation (which I shall hereafter call final renewals) must be included each year in the statement of the year's operating cost—that is, they must appear as debits or charges against the account Loss and Gain also known as Profit and Loss. I shall hereafter use the title "Loss and Gain" because it is somewhat more logical; the losses or debits appear on the left of the account and the gains or profits appear on the right side of account and so correspond with the order in the title. In the title Profit and Loss, this order is reversed, the word "profit" on the debit side and the word "loss" on the credit.

Bear in mind that "Loss and Gain" is an account in which the several accounts showing losses and gains are summarized, so that they can be balanced against each other and the final result of the year's business (loss *or* gain) determined by the debit or credit balance of the account.

Suppose we have an account called "Coal Account." If we buy coal the cost is charged (debited) to that account and at the end of the year the debit balance of that account, after taking account of stock of coal on hand, will be carried into Loss and Gain as one of the items of the year's operating cost. It will be on the Dr. or loss side. But if we transfer the charge for coal from Coal Account to Loss and Gain Account, we cannot leave the debit balance against Coal Account also open on the Ledger; if we did so, we should have two charges open on our books for the same item. So in transferring the charge to Loss and Gain, we *credit* a like amount to Coal Account to close or balance that account, and now we have the item for the cost of the year's consumption of coal appearing as *one* of the debit items of Loss and Gain; that is, one of the losses. The charge against Coal has not been wiped out but it has been transferred from the separate coal account to the general account called Loss and Gain as one of its debit items. So, *if we skip the intermediate steps*, when we pay cash for coal, we

credit "Cash Account" because it paid out the money for the coal and we debit Loss and Gain because the money paid out for coal is one of the items of the year's expense or loss.

What is true of coal is true of all the other operating expenses of the business, including manufacturing material, wages, rent, salaries, stationery, stamps, sales commissions, etc., etc.; and, of course, current renewals of plant and final renewals. That is, the losses of the year certainly must include the wear and tear on the plant.

If a belt breaks, or an armature burns out or a shutter blows off the building and breaks, these parts will be renewed and paid for out of Cash. Then Cash will be credited and the proper repair account will be charged or debited with the amount paid out on its behalf. I say the "proper" repair account, because for greater facility of analysis we should probably have more than the one repair account; for instance, "Steam Plant Repairs," "Electric Machinery Repairs," "Building Repairs," etc. But for greater simplicity *in our present discussion* let us assume that we have only the one "Repairs Account" to cover current renewals. At the end of the year there will be a debit balance against "Repairs Account" equal to the sum of all the current renewal items, unless this is reduced by some credit items for material or scrap recovered.

In closing the books the total cost of current renewals will have to be carried into Loss and Gain Account as already explained, and that we may not have a duplication of charges, we must credit "Repairs Account" with the amount transferred to the debit side of Loss and Gain, all as in the case of Coal. Repairs will now appear as one item of loss in "Loss and Gain Account" and therefore must not also appear in the separate account of "Repairs Account."

Now with Final Renewals (= Depreciation) we must get the estimated cost for the year into the account which summarizes the losses and gains for the year, namely, "Loss and Gain Account."

But this case is different from current renewals because we have no payment to make at once; we are only laying aside from

our income an amount which we believe will be later required to make good the accrued and constantly accruing liability for that part of the wear and tear on our plant which is not made good by current renewals paid for out of Cash.

In the case of current renewals we had a debit and a credit because we charged "Repairs Account" for the work done and we credited "Cash Account" for the money supplied.

In the case of final renewals we might decide to charge to some intermediate account before charging to "Loss and Gain," the same as we first charged current renewals to "Repairs Account" and later transferred the *several* items of the Repairs Account *in bulk* to Loss and Gain. Suppose, then, we first charge final renewals to Depreciation Account. (It will be seen that there is not the same reason for first passing into an intermediate account as in the case of repairs, because, unlike current renewals, there is only one charge for depreciation to make for each closing of the books and therefore we would only pass the item into Depreciation Account and immediately transfer it by cross entry to Loss and Gain Account, whereas, with current renewals, we employ the intermediate "Repairs Account" in which to group or classify the many items occurring through the year. But we will now use Depreciation Account to better explain all the steps.)

There is one point not covered. When we charged current renewals to Repairs Account we were able, as I have already shown, to make the entry complete by crediting Cash Account with the money paid out. We must then find a credit entry to balance our charge to "Depreciation Account," or we should have a debit without a corresponding credit. There was no payment from Cash so we cannot credit that account. As there is no actual transfer of cash, Cash Account is not involved. The entry is made to record the charge against the year's profit to meet an accrued liability and to show that this amount has been taken out of income and cannot be employed to swell profits or surplus. We want to show that this amount is set aside for a specific purpose, to redeem a loss later to be in evidence. Therefore, in charging to Depreciation (later transferred as a debit or charge to Loss and Gain) we credit the amount to "Depreciation Sinking

Fund Account," or "Depreciation Redemption" or "Final Renewal Fund," or any other title which will properly express our purpose.

You may say, if we give the amount to "Final Renewal Fund," why should we credit that account? But we do not give the money to that account. Cash Account still has control of it and may now be said to have *received* it from "Final Renewal Fund." Originally Cash Account received the money from some of our sources of income and credit was given at the time to the proper income accounts and debit was made to Cash. The condition has not changed with regard to Cash Account; it had the money in hand before the entry was made "Depreciation Account Dr. to Final Renewal Fund" and the making of that entry has not changed the responsibility of Cash *except that it is now responsible to "Final Renewal Fund" for this amount instead of being responsible to some other account or accounts as before.*

Let us go a step further, and suppose we decide to place the Final Renewal Fund in the hands of some Trust Company as Trustee, the Trust Company agreeing to pay say 3 per cent. compound interest. on the deposit. Then when we turn the fund over to the Trust Company we should charge the Trust Company and credit Cash; but the amount would still remain to the *credit* of "Final Renewal Fund" as it should.

Now consider this for a moment with regard to a statement of assets and liabilities. In such a statement the assets are found on the debit (left) side of the Ledger and the liabilities on the credit (right) side. For instance, if we pay out money for plant, or stock, or real estate, we charge those accounts and the amounts so charged appear on the debit (left) side of the Ledger and represent assets or money invested in property.

On the other hand, we *receive* money from stockholders, or bondholders and we have to credit those from whom we receive the money and the amounts so credited appear on the credit (right) side of Ledger and represent liabilities, or money received for which we must account. Now the "Final Renewals Fund Account" will show a balance on the *credit* side of Ledger, and therefore represents a liability, as it should do.

To summarize, Depreciation is charged to Loss and Gain (first passing it to the debit of Depreciation Account, if we prefer) and credited to Final Renewal Fund (or Depreciation Sinking Fund, if we prefer that title) and so we acknowledge the fact that Depreciation has been one of the losses of the year and establish the amount of that loss and we acknowledge that the cash value of this loss is set aside to meet this accrued liability and therefore cannot be employed for any other purpose. Cash Account and the other asset accounts involved acknowledge that they have the custody of these funds and must account for them when called upon to do so.

In my Notes on Repairs and Depreciation I have referred briefly to the case where depreciation is covered by reinvesting part of the earnings in extensions and betterments of plant, the separate earnings from these plant extensions being allowed to merge with the other earnings. I explain that, as the earnings from these extensions of plant could not be isolated or separately identified, it would be necessary to increase the amount to be so set aside to cover depreciation, as the amount set aside from year to year would not be directly assisted by interest accumulations. In this case the accounting steps would be quite simple, for the Journal entry would be to charge Loss & Gain, and credit the plant account involved. In this respect it would be similar to the case of depreciation in merchandise, as later to be referred to in connection with the analysis of a balance sheet. In this latter case the Journal entry would be:—

Loss & Gain Dr.	000.00	
to Merchandise		000.00
For depreciation of merchandise in stock, 2 % of $———.		

In the case of depreciation in plant, the entry would be:—

Loss & Gain Dr.	000.00	
to Plant Account		000.00
For estimated depreciation of plant during the fiscal year, ending ————.		

While the bookkeeping method that is suggested is, apparently, a simple one, it does not provide the means of readily checking up the accuracy of the estimated cost of depreciation, and, of course, it cannot be followed where the sinking fund scheme is employed.

It will be noted that by this method the debit balance of Plant Account is reduced by the items credited to that account and charged to Loss & Gain on account of depreciation, and thus the asset of plant is shown at a constantly reduced value, to correspond with the estimated reduction on account of depreciation. Suppose that we should each year expend in extensions and betterments of plant the exact amount required to cover depreciation. These expenditures would be charged to Plant Account, and so the original debit balance would be exactly maintained, and this would correctly represent the facts, for we should put into plant in the form of extensions sufficient extra value to compensate for the depreciated value of the original plant.

As I have stated to you repeatedly in my lectures, the item of depreciation is treated by accountants in many different ways. I have no desire to support any particular method, but I am chiefly interested in bringing you to an understanding of the fact that depreciation is to be reckoned with as a constant source of loss, and that by some consistent scheme of accounting a complete and self-explanatory record must be kept of this accruing liability.

ACCOUNTING APPLIED TO DEPRECIATION—CONTINUED.

MAY, 1904.

The *crediting* to Depreciation Sinking Fund of the amount set aside each fiscal period to cover depreciation of plant appears still to trouble a number of the members of the class. I will therefore make a further effort to show why this credit is made.

First let us again call to mind the fact that the plant, day by day, month by month, and year by year, will depreciate in value and this in spite of the current repairs or renewals put upon the plant and paid for out of the current income. We estimate that the several parts of the plant will have certain lengths of life and by the scheme which I have already described we determine what percentage of the cost of the plant must be set aside each year to cover the depreciation which has occurred during that period. If this were not done, the loss of necessity must fall upon capital.

The losses and the gains of any fiscal period we gather together under one account, entitled Loss and Gain. On the debit side we write up all the losses and on the credit side we write up all the gains. Let us now assume that every such item has been written into Loss and Gain Account *except this item of depreciation.* Then Loss and Gain Account will show the gross profits,—if any profits have been made,—which must be now reduced by the amount of depreciation. In other words, Loss and Gain Account now has to its credit a certain amount *to which it has no claim but which should be credited to some account which will hereafter be called upon to meet the payments for the renewal of the several parts of the plant as the times come for their final renewal.* We therefore make an entry debiting Loss and Gain with this depreciation item so as to take out from that account the credit which it should not have, and we credit it to an account entitled Depreciation Sinking Fund (or some

equivalent), the account which should have the credit *because later it will be called upon to stand the cost of renewals.*

You may still say, why should Depreciation Sinking Fund be *credited* with this amount when it is receiving it from Loss and Gain? But it is not receiving it. We are simply making an exchange of credits. Cash Account, or some other asset account, still has the actual money or its equivalent in hand.

Let us assume for simplicity that it is a matter of Cash and that the working capital is all in the form of cash. Then Cash Account has not delivered up to Depreciation Sinking Fund this amount of money, but we have simply made an entry to show that Cash Account instead of owing it to Loss and Gain Account now owes it to Depreciation Sinking Fund. If we should decide not to leave that money in the hands of Cash Account but to set it up as a separate deposit, then when Cash Account delivered it—say into the hands of the Safety Trust Company—Cash Account would *then* be credited (balancing the previous debit or debits when the money was entrusted to Cash Account) and the Safety Trust Company would be debited and we should now have two accounts which balance each other; the Safety Trust Company being debited with the full amount of the fund because the money had been entrusted to its care, and the Depreciation Sinking Fund being credited with the full amount because later we are going to debit this account with the cost of making good the several parts of the plant as they have to be renewed. We have reclaimed from our gross profits, year by year, the amount required to compensate for depreciation. If this amount were found on the books simply as an asset, say for instance as a deposit in the Safety Trust Company, it might be regarded as a part of surplus profits and therefore we would be at liberty to pay it out to the partners or stockholders as dividends; in other words, there would be nothing to show that this fund was in trust to be used only for a special purpose, namely the making good the impairment of capital through depreciation of plant. Now in addition we have the credit balance in favor of Depreciation Sinking Fund which shows that the amount deposited with the Safety Trust Company has been

received by us from Depreciation Sinking Fund to be later used for a specific purpose and not, therefore, to be regarded as part of suplus profits.

To help you to understand that there can be an exchange of credits or of debits without involving cash, let us suppose the following case:

Smith owes Robinson $100;
Robinson owes Jones $100; and
Jones owes Smith $100.

It is a triangular condition of debits and credits, thus:

SMITH'S LEDGER.

Dr. ROBINSON'S ACCOUNT. Cr $100

Jones' Account. $100.

ROBINSON'S LEDGER.

Dr. JONES' ACCOUNT. Cr. $100

Smith's Account. $100.

JONES' LEDGER.

Dr. SMITH'S ACCOUNT. Cr. $100

Robinson's Account. $100.

Now Jones says to Smith, "I will settle my account with you by giving you the benefit of my credit with Robinson."

Smith accepts the proposition and Robinson is requested by Jones to transfer his (Jones') credit to Smith's account.

Robinson then makes a Journal entry:

Jones	$100	
Dr. to Smith,		$100

which being posted in Robinson's Ledger debits Jones' account

$100 and credits Smith's account $100 for Jones' credit with Robinson transferred to Smith; which entries balance Smith's and Jones' accounts in Robinson's Ledger.

Jones makes an entry:

Smith	$100	
Dr. to Robinson,		$100

which being posted in Jones' Ledger debits Smith's account $100 and credits Robinson's account $100 for Jones' credit with Robinson transferred to Smith; which entries balance Smith's and Robinson's accounts in Jones' Ledger.

Smith makes an entry:

Robinson	$100	
Dr. to Jones,		$100

which being posted in Smith's Ledger debits Robinson $100 and credits Jones $100 for Jones' credit with Robinson transferred to Smith; which entries balance Robinson's and Jones' accounts in Smith's Ledger.

So all these credits and debits have been cancelled but there has been no transfer of cash in any case.

This not only serves to illustrate the point under discussion, but it also illustrates how much of the world's business is carried on by transfer of credits without cash changing hands.

SYSTEMS OF CLASSIFICATION.

ACCOUNTS "TAXES," "ACCRUED TAXES," "ADVANCE TAXES."

In my talks I have frequently referred to a certain book giving the scheme of classification developed by a committee charged with the duty of reporting a uniform system of accounts for a certain important industry.

This book gives the classification of operating expense accounts; classification of betterments or property accounts; forms of monthly journal entries and rules for closing. The report also includes blank forms for books and statements to be used in making the system effective.

To place the classification scheme intelligently before those interested, there is first given the report of the committee, then general remarks and instructions, then an index of the accounts, then a summary of the sub-divided operating accounts grouped under the respective general accounts, then each account is defined and explained in detail, a separate page (or more, if necessary) being devoted to each account. After these separate descriptions of the accounts there are given the forms for the regular monthly journal entries, then the "Rules for Closing Books at End of Fiscal Year," followed by the closing journal entries. These are followed by an index showing to what accounts the items of expense named should be charged.

The general accounts are indicated by letters of the alphabet and the sub-divisions of these accounts by numerals. For instance, "Manufacturing Labor," a sub-division of "Manufacturing Account," is shown as A-7, A indicating the general account "Manufacturing" and 7 the sub-division of that account, "Manufacturing Labor."

On the pages devoted to the detailed descriptions of the accounts appear first the title of the account with the account's letter and number, then a definition of the purpose of the account, then the items to be carried into the account, then—if need be—the journal entries involved and accompanying explanations, and, finally, general explanatory notes.

Thus, sufficient information is given to enable a bookkeeper to put the system into effect. In fact, in many cases, some of my associates on the committee thought that the explanations and notes were unnecessarily elementary.

After the description of the regular system of accounts follows a description of a "Junior" system, which was prepared at the special request of certain of those interested in the industry who felt that the full system would be "too complicated."

This junior system is simply a condensed form of the complete system. The general accounts of the fuller system are employed, but they are not so minutely subdivided.

In this connection it is well to quote from the committee's report:

"Your Committee, in preparing a junior system of accounts, has been influenced so to do by the expressed demand for a simpler system; but your Committee, in submitting a condensed system in accordance with this demand, would call attention to the fact that, while a condensation of accounts lessens the actual labor in the bookkeeping department, it distinctly adds to the labors of the conscientious manager, as it affords him less opportunity to effectively analyze his operating costs and make the proper comparisons, and such comparisons can then be completely made only by laboriously sub-dividing these condensed book accounts at greater cost, as the occasion demands."

In a business of any magnitude it is advisable to have the classification of accounts so shown in book form for ready reference. Questions, which are sure to arise, can then be promptly answered and *always answered in the same way.* The memory cannot always be safely relied upon in such cases.

I will now quote in full the descriptive matter in the case of three of these accounts, and I will use this material to explain in detail the questions involved in Advance Payment Accounts and Accrued Accounts.

It is to be noted that with these accounts there appears no

list of items properly chargeable to the accounts, because they have to do only with one item—taxes.

First recollect that in making up a statement of income and expense for any period there must be included all items of expense or loss, whether they have actually been so far paid or not; and we must take credit for such amounts as have been paid in advance, the whole payment or part of it being applicable to a subsequent period as an item of expense or loss.

Also liabilities which have so accrued must be so shown in the Balance Sheets of the following fiscal period; and assets which have been built up by advance payment must also be so shown.

In short, the total earnings and expenses of the period covered must be shown quite apart from the question whether the earnings are fully represented by cash receipts and the expenses by cash payments.

I have selected the case of taxes by which to explain this principle.

In the classification book referred to, the account of "Taxes" appears among the operating accounts; the account "Advance Taxes" appears among the advance payment accounts; the account "Accrued Taxes" appears among the accrued accounts.

I now quote from the classification book referred to:

"*Taxes.*

"This account is intended to show the amount of taxes, whether paid, due and not paid, or accrued but not due, applicable to the elapsed period of the current fiscal year.

"Taxes—City, County and State.

"To keep this account accurately, it is necessary to ascertain the specific twelve months for which each class of taxes is assessed and levied. If the period covered by tax levy corresponds with the fiscal year of the company, and the taxes are paid at the beginning of the period for which such levy is made, the amount when paid should be charged to 'Advance Taxes'; but if the taxes are due and payable at the end of the period for which such

levy is made, the amount when paid should be charged to 'Accrued Taxes.'

"If the period covered by any tax does not correspond with the fiscal year of the company, the amount of the tax when paid should be divided between 'Accrued Taxes' and 'Advance Taxes' in the proportion applicable to each.

"(Payments charged to 'Advance Taxes' shall always be for taxes covering a period *subsequent* to the date such payment is made, and payments charged to 'Accrued Taxes' shall always be for taxes covering a period *prior* to the date such payment is made.)

"Journal entries should be made each month charging 'Taxes' and crediting 'Advance Taxes' with the proportion (one-twelfth) of each class of taxes paid in advance and charging 'Taxes' and crediting 'Accrued Taxes' with the proportion (one-twelfth) of each class of taxes, accrued but not due, based upon the amount shown by the tax rolls, if made up, or if not made up, on an estimated amount based on the previous year's tax or any other reliable data.

"Taxes assessed for Improvements to be charged to Real Estate Account (see 'Real Estate').

Taxes 000.00
  Advance taxes..... 000.00
For proportion of taxes paid in advance
  applicable to the month of ——.
  One-twelfth of $..... = ...$.....
State and County, 1-12th of $.... = $....
City and School, 1-12th of $.... = $....
Taxes 000.00
  Accrued taxes..... 000.00
For estimated taxes accrued, but not due,
  applicable to the month of ——.
State and County, 1-12th of $.... = $....
City and School, 1-12th of $.... = $....

"NOTE.—At end of the year close this account (Taxes) into 'Loss and Gain.'"

This is the end of the page devoted to "Taxes."

(In the book in place of "Loss and Gain" is shown another

account into which the "Taxes" is closed on its way to "Loss and Gain Account"—for simplicity, I show it as going direct into "Loss and Gain.")

"Advance Taxes.

"This account is intended to show the amount paid for taxes covering a period subsequent to the date such payment is made.

"Credit this account and charge 'Taxes' Account each month with proportion of taxes applicable to this month.

"See following entry:

Taxes 000.00
    Advance taxes..... 000.00
For proportion of taxes paid in advance,
  applicable to month of ——.
  One-twelfth of $..... = ...$.....
State and County, 1-12th of $.... = $....
City and School, 1-12th of $.... = $....
"NOTE.—See 'Taxes' for full explanation."
This is the end of the page devoted to "Advance Taxes."

"Accrued Taxes.

"This account is intended to show the amount of taxes accrued but not due, covering a prior period. The balance of this account will at all times show the accrued liability for taxes.

"Credit this account and charge 'Taxes' Account each month with estimated amount of taxes accrued, but not yet due or payable—estimate to be based on previous year's tax bills, unless accurate method of estimating for current year can be arrived at. See the following entry:

Taxes 000.00
    Accrued taxes..... 000.00
For estimated taxes accrued, but not due,
  applicable to month of ——.
State and County, 1-12th of $.... = $....
City and School, 1-12th of $.... = $....
"NOTE.—See 'Taxes' for full explanation."
This is the end of the page devoted to "Accrued Taxes."

The explanations as contained in these three pages of the classification book would be all-sufficient for one familiar with accounts.

But I have found that you are not able from these descriptions to fully understand all the accounting steps to be taken in connection with taxes. I will therefore go into this matter in some detail with the purpose of explaining directly this particular case and incidentally Advance Payments and Accrued Accounts in general.

What has already been given you on the accounting features of Depreciation has furnished another example of the workings of an Accrued Account.

First turn back and read again the note in parentheses as quoted from the classification book under the head of "Taxes."

Now note that in both the Journal entries, "Taxes Dr. to Advance Taxes" and "Taxes Dr. to Accrued Taxes," the account "Taxes" is debited with one-twelfth of the total yearly payment for taxes. Thus all the charges for taxes are made through the Journal and when the cash is actually paid Cash will be credited and the charge must be made against some other account than "Taxes" or we should have this expense or loss account charged with an amount not warranted by the facts.

If a tax bill is paid, part of which applies to a period subsequent to the date of payment, that part will be debited to "Advance Taxes." Then the *debit* balance of this account will represent an asset, the asset being reduced in value monthly by the Journal entry:

Taxes 000.00
    Advance taxes 000.00

Here you see the cash transaction, and hence the Cash entry *precedes* the Journal entry.

In the case of taxes paid after the liability has accrued, the Journal entry

Taxes 000.00
    Accrued taxes 000.00

will have preceded the Cash entry.

The balance so built up to the *credit* of "Accrued Taxes" will represent a liability.

Later, when the cash is paid, Cash will be credited, and so much of the cash payment as is applicable to periods prior to the payment, will be *debited* to "Accrued Taxes," wiping out the liability balance built up by the Journal entries which preceded the Cash entry.

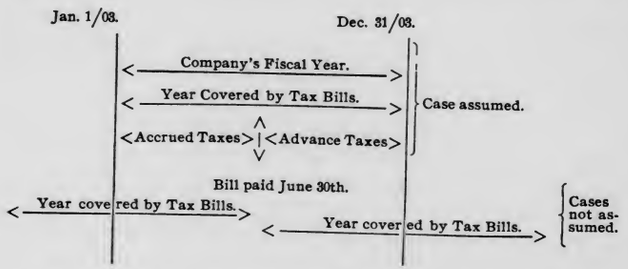
It is then to be particularly noted that in the case of "Advance Taxes" the Cash entry precedes the Journal entry, and in the case of "Accrued Taxes" the Journal entry comes before the Cash entry.

In the first case, an asset balance is set up by the payment of *cash* in advance, and in the second case a liability balance is set up by the charging up monthly to "Taxes" (a Loss and Gain account) the amounts for which the business has become liable, but for which the date of payment has not yet arrived.

Now let us take a fairly simple case and follow through the necessary Journal and Cash entries.

We will assume that the several tax bills cover the same year and that this year and the company's fiscal year coincide, and that the tax bills are paid June 30 of each year.

To make sure that I am understood, I give the following diagram:



The last two cases might be further varied by showing more or less of the tax year prior to January 1/03 (to the left of the January 1 vertical line) or by showing more or less subsequent to December 31/03 (to the right of the December 31 vertical line).

Further variations could be introduced by indicating different times for the payment of the tax bills.

In the case we have assumed, when the tax bill is paid June 30, one-half of the payment applies to the prior six months and the other half to the subsequent six months.

Now suppose we are carrying into our Ledger accounts each month all items of loss and gain.

Then for the first six months of the year we shall have to employ the Journal entry:

Taxes	000.00	
Accrued taxes		000.00
For estimated taxes accrued, but not due, applicable to month of (Jan. or Feb. or Mch. or Apr. or May or June) being 1-12th of $. . ., &c., &c.		

Then by the end of June we shall have a *Dr.* balance to "Taxes" equal to one-half of the total yearly charge for taxes (provided our estimate was correctly made) and a *Cr.* balance to "Accrued Taxes" of like amount, showing the liability established.

Now, according to our assumption, the tax bills are paid June 30.

Then Cash is credited for the total amount paid and one-half is debited to "Accrued Taxes" and the other half to "Advance Taxes."

The half debited to "Accrued Taxes" wipes out the Cr. balance which has been built up by the monthly Journal entries. This Cr. balance showed that the business was liable for that amount on account of taxes accrued. But, the business, through Cash, now pays this accrued liability, and so Cash is credited and "Accrued Taxes" is debited, the money having been paid on its account. So the records are now clear as far as "Accrued Taxes" account is concerned.

The other half of the Cash payment, debited to "Advance

Taxes," sets up an asset account. It gives a debit balance to "Advance Taxes," representing money paid out in advance which is to be paid back in service to be rendered by the State, County or City in the way of police protection, fire protection, street cleaning, &c., &c.

This balance to the debit of "Advance Taxes" will be reduced, month by month, by the entry:

Taxes	000.00	
Advance taxes		000.00

as already explained.

By the end of the year these successive Journal entries will wipe out this debit balance.

And so both "Accrued Taxes" and "Advance Taxes" will be balanced and "Taxes" will show a debit balance representing the total amount of taxes for the year.

By this method each month's cost has taken its share of the year's taxes irrespective of any question of time of payment of the tax bills.

But it may be objected that, without employing the Journal entries, the Loss and Gain account for the *year* would have only had to bear the charge for its year's taxes.

That is true in the case assumed, where the tax year and the company's fiscal year coincide, but it would not be so in the other cases more likely to occur.

Suppose that the tax year and the date of payment are such that part of the bill paid prior to December 31 applies to the subsequent year. Then, as explained, this portion will be debited "Advance Taxes," Cash taking credit for the total amount paid. Then the debit balance to "Advance Taxes" will represent as many twelfths of one year's taxes as there have been months paid in advance. That is, as many twelfths as have not been wiped out by the monthly Journal entries "Taxes Dr. to Advance Taxes" made subsequent to the payment of the bill.

This balance to the Dr. of "Advance Taxes" will be carried over on the Ledger to the next year and will appear in the Balance Sheet of January 1 as an *asset*.

Now suppose that the tax year and the date of payment are such that at the end of the year there is a certain portion of the year's taxes not paid. The liability has accrued but the bill to include these months will not be due and payable until some time in the company's next fiscal year.

Then we shall have a *Cr.* balance to "Accrued Taxes" built up by the monthly Journal entries "Taxes Dr. to Accrued Taxes," representing a liability for so many twelfths of the year's taxes as there are months accrued.

This balance to the Cr. of "Accrued Taxes" will be carried over on the Ledger to the next year and will appear in the Balance Sheet of January 1 as a *Liability*. As already explained, when during the subsequent year, the tax bill is paid, Cash will be credited for the total amount and "Accrued Taxes" will be debited for an amount equal to the Cr. balance, which balance will include the amount brought over from the previous year.

To further illustrate that "Accrued Taxes" and "Advance Taxes" appearing in the Balance Sheet of January 1 will represent a liability and an asset respectively, we may consider how Cash will be influenced by these accounts. Suppose there is carried over to the next year a certain balance to *Cr.* of Accrued Taxes; this indicates that taxes which have accrued and been charged to Tax Account as part of the year's expense have not been paid and therefore the cash on hand as indicated by the *Dr.* balance of Cash Account is that much larger than it would have been if this debt of the year had been paid. Hence we must show a liability to offset the additional cash on hand by reason of this debt.

On the other hand, suppose we have paid taxes in advance for a number of months of the next year, then a certain amount will have been taken out of Cash on account of next year and the asset cash will be correspondingly reduced. But the condition of the business as of January 1 is the same as though the cash had not been paid in advance, therefore the reduction of the asset cash is made good by the equivalent asset of Advance Taxes.

I have been asked, what happens if the estimate we make

for the entry "Taxes Dr. to Accrued Taxes," is not correct? In this, as in many other instances, we have to base our Journal entries on estimate. Here comes in the judgment of the man of business and here, in many cases must come in the judgment of the engineer. In case of a mistake, the correction must be made by Journal entry to correspond with the facts. As already explained, Depreciation is a case where very likely correcting entries will be required from time to time.

These steps, if carefully followed through, will show that by the double-entry system of bookkeeping we can make the accounts for each period show the period's proportion of all items of loss and gain and all assets and liabilities. It will be seen that if we guided ourselves only by the entries made to show cash received and cash disbursed, this would not be the case. The transfer of cash is only one feature of a commercial transaction, and in some transactions cash is not transferred at any time.

ANALYSIS OF A BALANCE SHEET.

DECEMBER, 1904.

While I appreciate that the instruction you have received in accounting as given in these notes and my talks has not been sufficient for a full command of the principles of accounting and the methods employed in double-entry bookkeeping, I still think that with the specific training you have received in this line and the general training in the line of straight thinking which you have received at "Stevens" you ought to be able to understand the following analysis of a trial balance and a balance sheet.

Under the circumstances, it may require a strong and sustained mental effort to enable you to comprehend all the points I shall bring out; but this is no more than you are continually called upon to do in connection with your studies on the technical side of engineering practice. Let me encourage you to make this effort, for if you succeed in fully comprehending what follows it means that you will have secured a good general understanding of the principles of accounting; and this in turn means more than most of you are capable of appreciating until you have studied in the school of experience.

For greater simplicity, I shall consider the case of a trading concern rather than a manufacturing or industrial concern. I shall introduce a few accounts which manifestly combine investment and speculative characteristics, to better enable me to make the distinction between the Asset and Loss accounts which appear on the Dr. (left) side of Ledger and between the Liability and Gain accounts which appear on the Cr. (right) side of Ledger. I refer to the following accounts: Phœnix Gas Bonds, Norfolk & Western R. R. Stock, and Erie R. R. Stock. Of course, the business as a whole is more or less speculative, as merchandise is liable to fluctuate in value while in our

possession and there are other speculative chances which must be taken in this, as in every other business.

Trial Balance.

December 31, 1903.

(Showing the Dr. and Cr. balances of all the accounts in the Ledger, taken off *before closing the books:* that is, before carrying into Loss and Gain Account the several loss and gain items of the fiscal year ended December 31, 1903.)

	Dr.	Cr.
Expense General,.....	$965.89	
Advertising	3,000.00	
Salaries and Wages.....	12,600.00	
Salary bonuses.....	500.00	
Traveling Expense	8,675.87	
Agents' Commissions.....	9,764.76	
Interest Account.....	845.65	
Store and Office Expense.....	6,576.83	
Bad Bills	785.00	
Cash	8,675.64	
Merchandise Stock	13,874.25	
Store and Office Furniture.....	3,184.27	
Phœnix Gas Bonds, 3/m.....	2,800.00	
Norfolk & Western R. R. Stock, 25 Shares.....	1,450.00	
Real Estate	4,500.00	
Advance Interest	650.00	
Interest Receivable	325.45	
Bills Receivable	5,000.00	
Accounts Receivable	6,745.87	
Merchandise		$60,650.25
Erie R. R. Stock.....		560.40
J. E. Thomas, Capital Account..		5,000.00
W. L. Sharp " " ..		5,000.00
J. E. Thomas, Personal Account		3,846.84

	Dr.	Cr.
W. L. Sharp, Personal Account.		$2,789.15
Interest Payable		465.00
Salaries Payable		1,540.00
Accounts Payable		4,567.84
Bills Payable		6,500.00
	$90,919.48	$90,919.48

Journal—Closing Entries.

(Being the entries made in the Journal as a basis for transferring to Loss and Gain Account the several loss and gain items shown on the Trial Balance.)

Dec. 31/03.

	Dr.	Cr.
Loss and Gain Dr.....	$44,087.00	
To Sundries,		
Expense General		$965.89
Advertising		3,000.00
Salaries and Wages.....		12,600.00
Salary Bonuses		500.00
Traveling Expense		8,675.87
Agents' Commissions		9,764.76
Interest Account		845.65
Difference between all interest debits and credits.		
Store and Office Expense..		6,576.83
Bad Bills		785.00
Store and Office Furniture.		95.52
3% for depreciation.		
Merchandise Stock.....		277.48
2% for depreciation.		

Dec. 31/03.

Sundries Dr.		
to Loss and Gain.....		$61,210.65
Merchandise	$60,650.25	
Erie R. R. Stock.....	560.40	
(profit on 30 shares.)		

NOTE.—The net profit of $17,123.65 as shown by the Loss and Gain Account (following) after posting above two entries, is now distributed to the two partners' personal accounts as shown by the following Journal entry:

Dec. 31/03.

Loss and Gain.....	$17,123.65	
J. E. Thomas, personal account		$8,561.83
W. L. Sharp, " "		8,561.82

The above three entries are made to close the books for the year ending December 31, 1903.

NOTES.—In the simple case here shown Loss and Gain Account is used only at end of fiscal period in determining the net result (loss or gain) of the business for the fiscal period, the profit or loss being then divided equally between the two partners, which again closes Loss and Gain Account.

In the first two Journal entries the facts could be correctly shown without including the words "Sundries," and even without including "Dr." and "to."

In the first entry the form then would be:

Loss and Gain.
  Expense General
  Advertising
  &c.

and in the second entry

Merchandise
Erie R. R. Stock
&c.
  Loss and Gain.

The third entry I have made in the simpler form as an additional illustration of how the bookkeeping method or form can be varied without involving any essential.

LOSS AND GAIN ACCOUNT.

	Dr.	Cr.
(From the Ledger.)		
Expense General.....	$965.89	
Advertising	3,000.00	
Salaries and Wages.....	12,600.00	
Salary Bonuses	500.00	
Traveling Expense.....	8,675.87	
Agents' Commissions	9,764.76	
Interest Account	845.65	
Difference between all interest debits and credits.		
Store and Office Expense.....	6,576.83	
Bad Bills	785.00	
Store and Office Furniture 3 %..	95.52	
Merchandise Stock 2 %.....	277.48	
For depreciation.		
Merchandise		$60,650.25
Erie R. R. Stock, (profit on 30 shares)		560.40
Balance carried down Profit..	17,123.65	
	$61,210.65	$61,210.65
Balance brought down—Profit for Term		$17,123.65

NOTE.—Above shows the Loss and Gain Account in the Ledger *after* posting the first two Journal entries and *before* posting the third entry crediting $8,561.83 to J. E. Thomas Personal Account and $8,561.82 to W. L. Sharp Personal Account. The posting of this last entry would balance the Loss and Gain Account.

It is assumed that there was no Loss and Gain balance brought over from the previous fiscal year.

BALANCE SHEET.

January 1, 1904.

(After posting all the closing entries from the Journal.)

Assets:

	Dr.	Cr.
Cash	$8,675.64	
Merchandise Stock	13,596.77	
($13,874.25).		
(277.48).		
Store & Office Furn.	3,088.75	
($3,184.27),		
(95.52)		
Phœnix Gas Bonds (3/m)	2,800.00	
Norfolk & Western R. R. Stock (25 shrs.)	1,450.00	
Real Estate	4,500.00	
Advance Interest (on B/P)	650.00	
Interest Receivable	325.45	
(On Bills Rec. $275.45)		
(On Phœnix Bonds 50.00)		
Bills Receivable	5,000.00	
Accounts Receivable	6,745.87	
Liabilities:		
J. E. Thomas, Capital Account		5,000.00
W. L. Sharp, " "		5,000.00
J. E. Thomas, Personal Account.		12,408.67
($3,846.84)		
(8,561.83)		
W. L. Sharp, Personal Account.		11,350.97
($2,789.15)		
(8,561.82)		
Interest Payable		465.00
Salaries Payable		1,540.00
Accounts Payable		4,567.84
Bills Payable		6,500.00
	$46,832.48	$46,832.48

I first show a Trial Balance taken from the Ledger at the end of the business day, December 31, 1903. If not actually taken off at that time, it is taken *as of that date:*—that is, any transactions which have occurred between that date and the time the Trial Balance was taken are not posted into the Ledger until the transactions for the year 1903—which we assume to be coincident with the fiscal year—have been finally adjusted preparatory to the books being reopened for the year 1904, or, if they have been posted, the work has been done so as not to mix the entries of 1904 with those of the previous year.

Next I show the Journal entries required to close the books for the year just ended.

In these entries all the items of loss and gain are transferred to Loss and Gain Account, so obtaining a summary and balancing of these several items. One entry charges or debits Loss and Gain Account for the sum of all the items of expense or loss, and at the same time credits each expense or loss account with the amount of its debit balance so that there shall not be a duplication of these debit items. The next entry credits to Loss and Gain Account the sum of all the items of gain and at the same time debits each gain account with the amount of its credit balance so that there shall not be a duplication of these credit items. The third entry credits to each of the two partners, J. E. Thomas and W. L. Sharp, one-half of the net credit balance of Loss and Gain Account resulting from the posting of the first two Journal entries.

Next is shown Loss and Gain Account as it appears in the Ledger after posting the first two Journal entries and before posting the third entry.

Finally comes the Balance Sheet from the Ledger showing the balances of all accounts after all the Journal closing entries have been posted. The items on this sheet are the balances brought down in the Ledger after posting all three of the closing Journal entries and after ruling off the accounts, reopening the accounts for the next year.

Your task now is to arrive at an understanding of the Baiance Sheet as derived from the Trial Balance. To assist you

in this I show in parentheses on the Balance Sheet against some of the accounts certain subtractions and additions which will serve to point out how these balances have been derived from the balances shown on the Trial Balance. These parentheses are not part of the Balance Sheet.

For instance, on the Trial Balance we find 13,874.25 to the debit of Merchandise Stock. That represents the amount invested in that portion of the merchandise purchased which remains unsold at the end of the year. Now in connection with the settlement of the firm's accounts for the year it is decided after full consideration of all the facts available that there should be written off to Loss and Gain Account for the year 2 per cent. of the book value of the stock of merchandise. So in the Journal entry "Loss and Gain Account Dr. to Sundries," we find depreciation included as one of the Sundry items and under this head there is $277.48, which is 2 per cent. of 13,874.25. In the Balance Sheet the reduced and present value of Merchandise Stock is shown as (13,874.25 — 277.48 =) 13,596.77, being the previous debit balance as shown on the Trial Balance, reduced by the credit for depreciation of $277.48. This subtraction is shown in the Balance Sheet in parentheses against the item, Merchandise Stock.

Also, against the items Store and Office Furniture, Interest Receivable, J. E. Thomas Personal Account and W. L. Sharp Personal Account, are shown in parentheses subtractions or additions to indicate how these items have been derived from the items in the Trial Balance.

If you will study the Trial Balance in connection with the Journal closing entries you will see that on the Dr. side there are accounts which represent assets and other accounts which represent losses; and on the Cr. side there are accounts which represent liabilities and others which represent gains.

Here, at first, there seems to be a contradiction.

The following rules, which I have before brought to your attention, help to explain this seeming contradiction, and if you will apply them every time you have an opportunity to study a

Trial Balance, you will find that your understanding of accounting and bookkeeping methods will rapidly increase.

Too often rules do not explain; here is an exception.

1. An item on the left or Dr. side of the Ledger

(*a*) is an *Asset* if the amount eventually will be received;

(*b*) is a *Loss* if the amount eventually will not be received.

2. An item on the right or Cr. side of the Ledger

(*a*) is a *Liability* if the amount will have to be paid eventually;

(*b*) is a *Gain* if the amount will not have to be paid eventually.

To put it a little differently:

If we have paid out money and it is to be returned to us, say by the sale of the thing in which the money has been invested, then the balance to the Dr. of the account involved represents an *Asset.*

If, on the other hand, we have paid out money which is not to be returned to us, it must be considered as a *Loss.*

If money has been paid to us and we have to pay it back, then the balance to the Cr. of the account involved represents a *Liability.*

If, on the other hand, we do not have to pay it back, it represents a *Gain.*

In connection with the Journal closing entries, apply these rules in analyzing the Trial Balance and Balance Sheet.

The Trial Balance shows us items of assets and losses on the Dr. side and liabilities and gains on the Cr. side.

But in closing the books for the year we have carried into Loss and Gain Account all the Loss and Gain items and the net profit has been distributed between the accounts of the two partners and so now appears as two liability items.

Thus we find on the Dr. side of the Balance Sheet only asset items, representing the property or things in which capital is invested and on the Cr. side only liability items showing from what persons or things the business has received its capital.

If the analysis is carried further it will be seen that certain of the accounts on the Dr. side *of the Trial Balance* in part

represent assets and in part losses. For instance, consider Merchandise Stock Account as already referred to. The Dr. balance of Merchandise Stock Account as shown on the Trial Balance is 13,874.25. But we have seen that $277.48 is an item of loss through depreciation and that Merchandise Stock as an asset account is reduced to 13,596.77, as shown by the Balance Sheet.

In the same way it can be seen that Store and Office Furniture Account as shown on the Trial Balance is in part a loss account and in part an asset account.

We also see that certain of the operating accounts are also included in the statements of Assets and Liabilities as shown by the Balance Sheet.

For instance, among the assets (Dr. side) we find Interest Receivable $325.45. This had been earned, but the time for its payment had not arrived. Still it is carried into Loss and Gain Account as one of the gains of the year. It is assumed that this amount will be received during the next year, so it is taken as an asset. When received, it will be credited to Interest Receivable, so wiping out this debit, and will not again appear as a gain in the Loss and Gain Account of the next year. The Loss and Gain feature of this amount has been taken care of once for all and now it only has to do with the Asset and Liability feature of the business.

On the other side, we find Salaries Payable $1,540, representing salaries which at the end of the year had been earned but which had not been paid. It is therefore a liability.

Coming now to the Securities Investment Accounts, we find on the Trial Balance and Balance Sheet the Phœnix Gas Bond Account debited with $2,800, which means that $2,800 has been invested in those bonds. That is therefore an asset account. If later the bonds are sold for less than the cost, the difference will be charged up as one of the items of loss; if sold for more than cost, the difference will be credited as one of the items of gain.

This applies also to the Norfolk and Western Railroad Stock Account.

But on the Cr. side of the Trial Balance we find the item

of Erie Railroad Stock $560.40. This item does not appear on the Balance Sheet. In the Journal entries we find this item included as one of the gains of the year, it being the profit on 30 shares of Erie Railroad stock. When the stock was purchased, the amount paid was posted from the Cr. side of Cash to the Dr. of Erie Railroad Stock Account. When the stock was sold, the amount received therefor was posted from the Dr. side of Cash to the Cr. of this account; and as the amount received exceeded the cost by $560.40 a Cr. balance of this amount was found in this account when the Trial Balance was taken off. So here is an account which formerly appeared on the Dr. side of the Balance Sheet, as representing an asset, now appearing on the Cr. side of the Trial Balance as representing a gain.

Now, let us test the items on the Trial Balance by the rules I have given for distinguishing between Assets and Losses on the Dr. side and between Liabilities and Gains on the Cr. side.

The first nine items on the Dr. side are losses, for they will not be received.

The next item, Cash, can be claimed at any time, and it is an asset.

The next item, Merchandise Stock, is an asset so far as we believe it will be received and a loss to the extent that the amount debited to the account is in excess of the amount we estimate will be received; all as before explained.

Store and Office Furniture is part asset and part loss, as in the case of Merchandise Stock.

Phœnix Gas Bonds is an asset account, as no reason appears for believing that the amount to Dr. of the account is in excess of the value of the bonds represented.

Real Estate is an asset account as representing real estate worth $4,500.

Advance Interest is an asset account, as it represents the payment in advance for the use of money. If the loan were cancelled December 31, 1903, we can assume that this $650 would be returned. If the loan is not cancelled we can assume

that this $650 will be received through the use of the money on which this advance interest has been paid.

The next three items represent amounts to be received, and are therefore asset accounts.

Turning now to the Balance Sheet, we find the first nine accounts do not appear as they are loss accounts, but the last ten do appear as asset accounts, though Merchandise Stock and Store and Office Furniture in reduced amounts, as explained.

Coming back to the Trial Balance, the first item we find on the Cr. side is Merchandise. This will not have to be paid, for it represents the year's profits made in the purchase and sale of merchandise; it is therefore a gain.

Erie Railroad Stock, for the same reason, represents a gain.

The next two accounts represent the amounts loaned to the business by the two partners. These amounts will eventually have to be paid, and therefore represent liabilities.

The next two accounts represent the profits credited to the partners which have not yet been withdrawn. These amounts will have to be paid, and are therefore liabilities.

The next two accounts represent amounts which have been earned against the business but have not yet been paid; eventually they will have to be paid, so they are liabilities.

The next item represents approved accounts for services we have accepted or for goods we have used or have on hand. These accounts must be paid, so "Accounts Payable" represents a liability.

The next account, Bills Payable, represents notes which we have issued in payment for services or goods, and as these notes must be paid, the account represents a liability.

Turning again to the Balance Sheet, we do not find the items "Merchandise" and "Erie Railroad Stock," the two gain accounts, for they have been carried into Loss and Gain Account, but we do find the last eight accounts representing items of liability.

Finally, it must be understood that the condition of the business has not been altered by the changes which are shown by a comparison of the Trial Balance with the Balance Sheet.

Since the Trial Balance was taken off there have been no further business transactions, or if there have been any, they have not been taken into account in preparing the Balance Sheet. Certain adjustments for depreciation and the like have been made. The facts as they before existed have been acknowledged and recorded. The differences between the Trial Balance and the Balance Sheet result from bringing together all the loss and gain items, balancing them against each other in Loss and Gain Account, and the crediting to each of the partners' personal accounts one-half of the credit balance to Loss and Gain Account obtained by deducting the sum of the loss items from the sum of the gain items.

Having so closed the books and ruled off the accounts in which the sum of the debits equals the sum of the credits, and brought down all the Dr. and Cr. balances in the case of accounts in which the sum of the debit items and the sum of the credit items are not equal, the books are ready to receive the entries for 1904 and now the loss and gain accounts will be reopened.

The case I have taken as an example is a very simple one.

It can readily be seen that, in a manufacturing business, the accounting and bookkeeping complications are greatly increased.

In the case of a large manufacturing concern it would be necessary to keep the books so that all steps in each branch of manufacture would be clearly represented in the accounts. To this end the accounts would be divided and sub-divided so that the items of cost would be classified to correspond to our proposed analysis of costs. A scheme of classification which thus multiplies the number of accounts to provide the means for ready and accurate analysis of costs may be considered complicated and burdensome by the bookkeeping department, and is frequently objected to by bookkeepers on that score. It is then to be remembered that in the case of a large business it pays to so increase the labor and expense of the bookkeeping department provided the manager and his assistants are thus

provided with the facilities for constantly keeping themselves informed in the minutest detail of the cost of operation. For a concern doing a large and complicated business nothing could be more complicated than a condensed classification of accounts, for the analysis of costs could then be effected only by picking out of these condensed accounts, item by item, the information required. This should be provided for in advance through the adoption of an extended scheme of classification designed to present the business records in the most complete and convenient form for the information of the management at any and all times.

I hope we may have time to take up this branch of our subject in connection with a consideration of store-room inventories and shop cost.

ANALYSIS OF DATA.

DECEMBER, 1904.

In this course of lectures on some of the features of engineering practice, I wish to give at least brief attention to the important subject of analysis of data.

In your professional work you will continually be called upon to refer to the record of experiences and opinions of others. You will consult text books, the transactions of technical societies and other authorities more or less qualified. Before accepting data, and especially so when some definite question is at issue, you should form an opinion as to its reliability and comprehensiveness.

In collecting your evidence you will have to deal with conflicting, or apparently conflicting, statements. First, you should determine whether or not the statements are conflicting, and if you so decide you must then determine their relative values. Frequently, a careful analysis will show that there is no real conflict, for the statements do not cover exactly the same ground, and, therefore, cannot be fairly compared.

I have already pointed out to you the danger of accepting any partial or incomplete statements. I have told you of instances in my own experience where partial statements of two or more men, of acknowledged repute as experts in their line, and reputed to be honest, had been so combined as to give an apparently complete certificate of good character to some process or device. In many of these cases, my investigations have shown that these statements, which, when combined, appeared to offer a sufficient guaranty of efficiency, had not been prepared as the result of coincident investigations, and, therefore, were worthless when so combined to form a complete record.

I think of an instance where two such partial statements were signed by two professors of a college of engineering of the first rank. One certificate furnished a most satisfactory

verification of the claims made as far as quantity of product was concerned, and the other furnished an equally satisfactory verification of the claims as to quality. The adroit promoter had so combined these two statements in the prospectus of the company as to satisfy the ordinary investor so that he was willing to risk his money in the venture. These professors, as ordinarily careful and intelligent men, should have known that the claims made for the process—considering both quantity and quality—were impossible of accomplishment, and that to obtain the results claimed would furnish a demonstration of perpetual motion. And, yet, these professors were each willing to give a certificate for the isolated results as they saw them without going deeper into the subject. My own investigations proved that if the result as to quantity was obtained, then it was impossible to verify the claim as to quality, or if the claim as to quality was verified, the claim as to quantity was impossible of verification. I could cite many such cases from my professional experiences.

This all indicates that in the analysis of data we must be careful to include in our investigations all the points involved; especially we cannot safely take any isolated statements or even any isolated facts. We must read every statement with its context, and, as honest and intelligent men, if we quote a statement of fact, or opinion, we should quote that statement with its context, and we should ourselves be careful to bear in mind the context.

Take, for instance, a case in my own special line of work—gas engineering. We frequently find comparisons made of gas leakage on the basis of per cent. of output. In one city, the leakage (so called) may be 5 per cent. of the total output; whereas, in another city, the leakage may be 10 per cent. of the output, and still, the latter may, upon even superficial investigation, indicate greater efficiency of plant and management. This may be readily seen. Suppose we have two companies, A and B, with exactly the same mileage of mains and exactly the same leakage, as measured by the per cent. of volume sent out or as delivered to the mains. But we find that A is sending

out twice as much gas as B. Or, to be more definite, let us suppose that A is sending out 200,000,000 cubic feet per annum; whereas B is sending out only 100,000,000 cubic feet per annum. Let us suppose, further, that the leakage in each case is 5 per cent. of the output. Then, the actual amount of loss by leakage in the case of A is 10,000,000 cubic feet per annum; whereas the loss of B is only 5,000,000. So we find that B's leakage is only one-half the leakage of A, in spite of the fact that by the statement in the form of per cent. the leakages are equal.

To still more completely show that leakage of several companies cannot be compared on the basis of per cent. of output, suppose we have a company which has just completed its main system and turned the gas into its mains but has not yet connected up the mains to any of its consumers' meters. In this case, all the gas that passes from the mains would be leakage, and hence the leakage would be 100 per cent.

In spite of the facts here shown, there are many people in the gas business who make their leakage comparisons on the per cent. basis. For instance, they see that a certain company has a leakage of 5 per cent. of its output and they are, therefore, satisfied that the mains are in fairly good condition and that the management is satisfactory. They see another case where the leakage is 10 per cent. and they assume that the mains are in unsatisfactory condition; whereas it is quite possible that, in the latter case, the distributing plant is in better condition than that of the first case. The large per cent. of leakage may, of course, indicate that fault may be found with the sales department, but the efficiencies of the two departments are not to be confounded.

This leads me to point out that the intelligent analysis of data is required when we are attempting to make comparisons between the efficiencies of management of the several departments of a single concern. In connection with my talks on accounting, I have tried to impress upon you the fact that if we are to obtain the most economical management through the many steps included in operation, we must be able to determine through a systematic statement of items of cost exactly

where there is room for improvement and where we may, at least for the present, be satisfied with the result obtained; so, in connection with our present subject, we must be prepared through a careful consideration of all data available to determine as to the relative efficiency of the management of the various departments of any business in which we may be concerned. I am reminded of something that happened some years ago. I shall not go into the details, but it is sufficient to say that in connection with the arguments made from time to time for the introduction of an improved form of retort furnace and setting, an old engineer in charge of one of the largest plants in the country repeatedly stated that his old benches, antiquated in design, cost him much less money to install and were giving just as good results as those claimed for this new and more expensive form. His works later came under my management and I then found that there was apparently a very large leakage, amounting to about 33 per cent. of the output. Investigation proved that the mains were in better condition than any other part of the plant and the superintendent of the mains was the most efficient official in the company's service. The explanation of this apparent conflict in the facts was suggested when I discovered that the statement of the amount of gas manufactured was obtained by a system of estimating. There was not sufficient station meter capacity to register the total amount made, so from time to time experimental runs were made, the gas being measured through a small meter. The total coal carbonized was credited with the rate of production established by these experiments. Further investigation proved that these experimental or test runs were entirely unreliable as a basis of estimate. As soon as the gas was correctly measured the statement of gas produced was materially reduced, and so the statement of the amount sent into the mains was reduced, and in turn the per cent. of leakage was reduced. Thus it was shown that the management of the works was much less efficient than the records had indicated, while the management of the distribution department was much better than the records had indicated. Furthermore it was found that the claim made that the old-style

benches were as efficient as the improved (regenerative) benches was entirely without warrant.

When we are called in as engineers to investigate any proposition as to the worth of a plant or a business, we at once have to call in our powers of analysis. A man who is not capable of fairly and intelligently analyzing data is worthless as an investigator. A large part of my professional life has been spent in the investigation of claims more or less extraordinary. I believe I am correct in saying that in a majority of these cases where specific claims had been made as to quantity and quality of product, upon going to the works to investigate, it has been discovered that there were no means on the ground for completely measuring quality, or quantity or both, and that these extraordinary claims had been derived from more or less elaborate systems of estimation in which the wish was father to the claim. For instance, I at once call to mind one case where the most extraordinary statements had been made in regard to the quantity of gas produced from a given quantity of coal. These statements had been widely accepted and many men of standing in the business world had been induced to invest in the company controlling the process. Certificates had been furnished by engineers who were supposed to be capable and honest. When we undertook the investigation, we found that there was no station meter for measuring the quantity of gas produced, and the measuring was done by noting the rise and fall of a gas holder, and this without allowing for change of temperature which amounted sometimes to as much as 40° Fahr. Furthermore, it was found that the amount of coal used had been determined by the use of small platform scales and that there was no evidence that the coal, as supplied to the apparatus, had always been weighed. The records of ordinary laborers had been taken in this case. When we came to check up the treasurer's books with the coal pile, we found that the latter was "short" and that nearly twice as much coal had been used as had been included in the statements of cost.

Again, in the case of gas process investigations we have to test the claims as to quality by accurate measurements of

candle power and calorific value. I call to mind a case, and a most important one, where the gentleman whom I was assisting had come from Europe for the express purpose of investigating the claims made for a certain process. The investigation was carried on through a number of different works. At one of these, when we came to use the photometer to determine the candle power of the gas, we found that the sight box could be moved through a range of four candles without making any marked difference in the distinctness of the image on the disc; and, yet, this photometer was in charge of a man who had an unusually good reputation for his ability in laboratory observations. I think of another instance where a certain engineer had been for years claiming that, by his method of scrubbing and condensing, the gas acquired or retained an additional illuminating value of two candles. Later, these works came under my direction and I found that the photometer *upon whose accuracy these claims for increased efficiency depended* was out of adjustment at a number of points, the candle balance was non-sensitive and the Bunsen disc had been in use for about ten years and had long since outlived its usefulness. As soon as the photometer was re-equipped and re-adjusted it was found impossible to detect any increase in candle power due to this special method of scrubbing and condensing. Still, these claims had been accepted on the reputation of the inventor and considerable apparatus had been sold by reason thereof.

In making our comparisons on the relative cost of product or on relative efficiency of plant, we must be careful not to magnify the importance of any one item at the expense of any other item, or, worse yet, at the expense of all the other items. While the case must be considered with regard to each of the individual items, we must also consider the case as a whole.

Again, I am reminded of an experience where we were endeavoring to eliminate a waste due to heat escaping from a certain piece of apparatus. We devised an addition to the apparatus which was intended to recover a large portion of this heat. At first the result was most encouraging and we were apparently making a satisfactory saving on each thousand feet

of gas produced. At the end of six months, however, the repairs on this additional apparatus had increased until the cost for repairs was twice as much per thousand as the apparent saving.

In making our investigations, we should be sure that the instruments used for our measurements are completely adjusted and standardized. For instance, in the case of gas investigations we should be certain that the means employed for measurement of volume are correct and that the photometer which is used for the measurement of candle power is accurate. We should, still further, be positive that the gas we are measuring is the gas that is being produced. I recall an instance where, after two weeks of hard work, the men engaged on the investigation found that they had been measuring for candle power gas taken from another pipe than the one they had supposed. In other words, their measurements of volume were correctly taken but the measurements for quality were made on gas produced by another apparatus.

I will give you another instance by quoting from a letter received not long ago:

"Recently we had occasion to make a fuel test and I found that the man in charge failed to properly test the scales before use.

"He was weighing wagons of approximately 1,800 pounds each. The test he made of the scales was to stand a man in the centre, get his weight, stand him at each corner and get his weight, and find that each time the weight of the man was shown to be the same as when he was weighed on the standard scales. This was regarded as satisfactory evidence that the scales were correct. I believe that further it was determined that the scales worked freely—turning for a small additional weight, and that everything was clean about the pit.

"After the test had gone on for some time it was found that the scales were not weighing the same as another set of scales, and it was ascertained that the platform and its supports were not sufficiently rigid and had been bent under the 1,800 pounds weight."

In short, in all of our investigations we should be sure that the methods we are employing are giving correct and complete statements of fact and we should never accept any other person's say-so if there is any possible way of investigating for ourselves. When we do accept the statement of someone else, that fact should be shown. If we sign a report, it should be because we have personally verified all the statements contained therein, or we should qualify our statements, where necessary, by stating our authority.

Or to state it more briefly:—

Be thorough.

Do not be led.

Keep your wits about you.

Use your common sense.

State what you know.

ESTIMATES AND SPECIFICATIONS.

DECEMBER, 1904.

Incomplete as this collection of Lecture Notes is, failing as it does to specifically touch upon some important business features of engineering practice, I feel that some definite reference to estimates and specifications must be included.

In my talks I have frequently made incidental reference to this branch of my subject, and especially when describing and illustrating the use of the statistical and auxiliary books which, combined with the regular books of account, should provide a complete record of the transactions of an industrial concern.

First we have to bear in mind that we must consider this subject from the standpoint of the buyer and also from that of the seller. Some of you as contracting engineers or manufacturers will have to submit to the stipulations contained in the specifications and contracts prepared for your guidance and control. Some of you after so contracting may sublet parts of your contract to others and so become interested in the preparation of such specifications and contracts as will in turn guide and control those whom you are bringing in to share your responsibilities.

Again, some of you as consulting engineers may have to occupy a more neutral position in representing the purchaser, or standing between the purchaser and the manufacturer or contractor.

So what I have to say should be capable of fair application by either party to a transaction in which is involved an estimate, a specification and finally a contract.

In case of any piece of work to be performed the first thing required preliminary to a contract, is that the exact character of the work shall be fully and explicitly defined.

This calls for the preparation of exact and comprehensive engineering drawings. While I know that this part of your

technical training has been fully cared for in other of our departments, still, before passing on let me emphasize as an important feature of engineering practice that all engineering drawings should be completely self-explanatory and should be checked up in every possible way before we employ them in connection with a specification as part of a contract. Unfortunately, it is too common an occurrence to find that the several parts of a drawing or set of drawings do not support each other as to dimensions or features of design or both.

For a piece of work of any importance specifications should be carefully prepared and made to agree in every particular with the engineering drawings. It will frequently be found that the effort to bring about this agreement will indicate the necessity for modifying the drawings or the specifications or both.

For the moment, I cannot think of any one thing included in engineering practice which is of such vital importance from both the technical and the commercial standpoints as this preparation of drawings and specifications complete, comprehensive and exact in all necessary details and in perfect harmony with each other.

In the case of work of any magnitude, only by such complete planning ahead can the best possible result be obtained from the minimum of capital expenditure. Here it is to be seen how the technical and commercial features of engineering practice are interwoven from the very beginning of any industrial undertaking.

Where a certain class of work is being frequently repeated, with comparatively minor modifications to meet local or special conditions, standard drawings and standard specifications should be developed. As soon as any difficulty appears in connection with any one undertaking from which we can gather experience for future application, the standard drawings and specifications should be modified; or, if a general modification is not deemed advisable, notes should be made for our guidance in any similar future case.

If in the same business a number of lines of work are followed, as many sets of standard drawings and specifications should be prepared.

For each special line an estimate book should be developed in which there shall appear every item that experience has shown will be required. This in turn should be supplemented when experience shows us, as it unquestionably will, that in our previous estimates some items were omitted. The last item on the list, one that should never be omitted, is that of contingencies; for no matter how careful or conscientious we have been to include separately all sources of expense there will be some omitted. For in every engineering undertaking in which variations are introduced through change of location or other of the limiting conditions, there will be required a change in our specifications. Furthermore we must include a contingency item because we cannot determine in advance the cost of the unavoidable chances which enter into the performance of every piece of engineering work of any importance. Some engineers provide for contingencies by making a liberal estimate of cost on each important item. I prefer to place against each item what I believe will be its cost as exactly as I can estimate it on present market conditions and then add one item for contingencies, say in ordinary cases 10 per cent. of the total cost of all the specific items. The cost of each item must include the cost of placing the material or the men on the ground where the plant is to be erected or we must include as separate items the cost of transportation, including freight, carting, insurance, &c. In making up the items of an estimate we must be careful to see that there is no gap between the items which cover transportation and the items which cover erection. Not infrequently, actual cost exceeds estimated cost because material has to be stored and rehandled after delivery and before erection or because wages have to be paid to men waiting for the opportunity to commence their work.

An intelligently prepared estimate book can be made to be worth many times its weight in gold. Such a book, modified and corrected from experience is of the utmost value in the preparation of specifications for future undertakings. Its

records, including the special data in each case, should supply the means for making as correct an estimate as is possible. But even if we exercise all possible care and intelligence to correctly cover all other items of cost, this item of contingencies cannot safely be omitted, and in certain special cases it must provide for elements so uncertain in their character that a considerable risk must be taken or a large amount must be included to ensure safety. If the estimate is prepared as the basis for a competitive bid on work to be performed, such a necessarily large contingency item may be a decided disadvantage, for one or more of the other bids may be offered by those reckless or dishonest enough to take their chances without so ensuring themselves against loss, on the theory that if the cost goes against them they will be able to escape from the full force of the contract by one means or another. In such cases, the honest and careful contractor cannot allow himself to be influenced by fears as to what his competitor may be willing to do.

From an estimate book such as I have outlined, another book can be developed, which may be employed to the greatest advantage in the actual performance of the work. As work under a contract progresses, especially if the work is being executed at a point far removed from the home office, it is of vital importance that those who are responsible at the home office for keeping the resident engineers supplied with the necessary material and men, should constantly have before them a record, correct to date, of the ordering and forwarding of material and men and of their arrival or non-arrival on the ground. This book then should have columns so prepared that against each item can be recorded all the various steps taken between the ordering and the actual completion of the work. It is therefore important that spaces should be provided for necessary notes in regard to working drawings and modifications and additions thereto, the necessity for which may develop as the work progresses.

The resident engineer should be notified of all drawings, material and men forwarded and he should be required to promptly acknowledge their receipt. All these steps should be

noted in this estimate or contract record. The notifying of the resident engineer may well be done through carbon copy books, so that we may be sure that the original sent to him is an exact duplicate of the carbon copy retained in the home office. These carbon copy books may be conveniently used for illustrating by sketches minor details required to modify or further explain features of construction on which questions have arisen during the progress of the work and which have been referred to the home office for further explanation or decision. The orders for material should also be made out on carbon copy books so that one copy may be sent to the concern from which the material is ordered, one copy to the resident engineer in charge of the erection and the third retained in the home office.

As I have said, every one of these steps, *as they are taken*, should be noted in the Contract Record Book according to a prearranged system. The final vertical column in this record should be one to show the total cost of each item, there being other columns to show how this final cost is made up.

When the contract is completed this contract or estimate record should be checked up with the treasurer's books to make sure that the cost as shown in the book which is to guide us in future estimates exactly corresponds as to total cost with the figures shown in the regular books of account. To the inexperienced student it may seem strange that I take the time to make this point; but this is vital in the operation of such a scheme as I have now barely outlined. It is true, unfortunately, that here and in many other directions, the statistical and auxiliary books of an industrial concern are not always made to balance with the regular books of account. Very often these two classes of books are kept in different departments—the regular books of account in the Commercial Department and the auxiliary books in the Engineering or Construction Department; and not infrequently, sufficient friction exists between these two departments to prevent them from loyally co-operating to obtain a complete result, so necessary for the good of the business. The man then who is responsible for the business as a whole should see to it that this co-operation is developed and con-

stantly maintained. But if the manager is a technically trained engineer who regards bookkeeping as something below his dignity as a professional man, he will not be ready in the first place to call for such co-operation nor, in the second place, will he be competent to ensure it by proper supervision and direction.

Now let us go back to the more specific consideration of the preparation of the specifications.

It can readily be seen that an estimate book such as I have outlined can be employed to great advantage in the preparation of specifications, provided the concern which operates the book is responsible for the preparation of the specifications. Such is not always the case, but often it is so.

Even in the case of a consulting engineer, some such record as I have outlined would be convenient, if not actually necessary. Again, frequently the one charged with the responsibility of preparing the *final detailed* specifications, which after acceptance are to be attached to and become, with the drawings, a part of the contract, is the contractor.

If, on the other hand, the bids are called for by a concern which is not definitely informed as to what should be required under the proposed contract, the probabilities are that such a concern will call in to its aid a consulting engineer or put itself at once in the hands of some contracting specialist who has by his integrity, common-sense and professional ability earned for himself a reputation upon which broad-minded business men will be willing to place their dependence ahead of everything else.

Suppose now we have prepared an estimate in our estimate book as the basis for a bid, this bid to be accompanied by a specification, more or less clearly itemized according to the present requirements. The details as given in our book may be quite plain to us, but now the question comes up, will they be perfectly plain to the other party to our proposed contract? This at once brings to our notice the fact which I so frequently try to impress upon you, that a sound working knowledge of the mother tongue is of vital importance to the engineer. Not only must the specification convey to *us* a description of the

items covered in our estimate, but it must convey that meaning to the *other party* of the proposed contract.

While it is desirable that the specification shall be expressed in language precise and concise, it is far more desirable that it shall be expressed in language admitting of only one meaning, no matter how inelegant that language may be. We should not hesitate to use the same words over and over if we are sure that our meaning can be thus made more certain of correct interpretation. We must bear in mind that if we make an apparently plain and simple statement of fact before an audience limited in number, hardly two of the listeners in that audience will have conveyed to his mind by the spoken words exactly the same impression. This should constantly influence us to exercise watchfulness and care even in the preparation of our less formal business communications. As I have pointed out in my talks on commercial law, much of our correspondence is to be classed as the groundwork for contracts of one kind and another, and carelessness in expression may, to our surprise and disgust, lead us into annoying and expensive lawsuits. I have also shown you from my own experiences how the haste which leads us to write communications that are not completely self-explanatory in the first instance entails upon the sender and the receiver the expenditure of time and nerve energy many times greater than that which would have sufficed in the beginning to have made the initial communication complete. You will remember that I gave one instance where I arranged for the exhaustive analysis of all of one class of correspondence passing through a certain office during six months. The result was a surprise to all concerned. It was found that the record of letters written which would have been unnecessary had the initial communications been correct and complete in every detail, ranged from 102 letters explaining and correcting 6 monthly reports to 10 letters explaining and correcting 9 monthly reports.

Bear in mind that many of these men whose records were so analyzed were technical graduates.

For the warning of those of you who are inclined to slight what some ignorantly and foolishly classify as little things, and

for the encouragement of those of you who are thorough and conscientious in details, let me point out that in the business world where such inability and indifference or lack of conscientiousness are continually made apparent in unsatisfactory results, how the over-worked, harassed manager of today must turn with open arms to the—I am sorry to say—exceptional employe who lightens his pressing burdens by completely performing the tasks assigned to him. Young men often complain to me because, as they say, there are not the same opportunities to make their way as there used to be. There always will be this opportunity for the capable, thorough and conscientious men any time this side of the Millennium, and that is about as far as we need look.

In spite of all the care, intelligence and specialized training which may be exercised in the preparation of specifications it is still impossible to avoid all mistakes and disputes as to interpretation.

Apart from differences of interpretation of words, meant by the engineer to express a definite thought or intention on his part, cases must arise where it becomes necessary, or is considered advisable, to modify the original plans by reason of facts which first come to light after the work has been begun.

The items for extras are a fruitful cause for dispute in connection with the settlement of contracts. Unfortunately, some contractors endeavor to provide in their contracts a place for the later introduction of extras, hoping thereby to get pay at higher rates for part of the work and at the same time lead the other party on to the making of a contract by holding out the bait of a low lump-sum contract price. The conscientious engineer and contractor should do all in his power to reduce to a minimum the necessity for extra charges.

When it becomes apparent that such extra charges will have to be made or when it becomes apparent that modifications of the specifications are required, steps should at once be taken to arrange a supplementary agreement between the two parties to the contract, rather than leave the matter in indefinite shape as the probable cause for dispute or possible litigation at the time of final settlement.

The several clauses of a carefully prepared specification may be divided into two classes:—

General Clauses, which define the general conditions under which the contract shall be executed, the relative responsibilities of the two parties to the agreement, the lines to be followed in regard to acceptance on the part of the buyer, terms of payment, and the like; and

Specific Clauses, which cover the details of design and construction.

It is well to carefully separate and classify the several items of the specifications in this way, bearing in mind that then the specification becomes the very substance of the contract.

The general clauses can commonly be made standard, to apply almost without alteration to all contracts of a certain class. This portion of the specification form should therefore be amended and added to as experience suggests. The original form and *all changes* should be submitted for approval to a competent legal adviser. It is well here to remind you that whenever a doubt is suggested as to the best form in which to express a business paper so as to secure the maximum of protection under the law, go to a good lawyer. You believe it is wise for those not specifically trained in engineering science to consult a specialist as questions in that line arise; you, then, should be prompt to recognize the wisdom of engineers consulting lawyers when the special question to be solved is one of the law.

I shall not here attempt to set before you specimens of specifications as actually employed in the field of engineering. Such examples would necessarily vary very greatly with every branch of engineering considered. It would be only in general that such examples could be employed to advantage in such a crowded course as ours at "Stevens," especially as we find by our Alumni Directory that our graduates by no means confine themselves to the one branch of engineering which, for want of a better name, is styled Mechanical Engineering, but are to be found occupying positions of importance in every branch of engineering practice.

I would strongly advise you, however, as you settle down to practice in any one branch of our profession, to make a special effort to collect representative specifications from engineers of good repute. These men will frequently be found willing to furnish such specification forms in individual cases where they might be unwilling to furnish them for inclusion in these notes, which are intended for more or less general distribution.

I would especially advise all of you to procure, if possible, a copy of the lecture on "Specifications" delivered before the Senior Class of Rensselaer Polytechnic Institute, April 30, 1903, by Dr. J. A. L. Waddell, of the engineering firm of Waddell & Hedrick, Kansas City, Mo.

I have not so far prepared anything specific with reference to that important business feature of engineering practice; namely, the necessity for practicing within the limits set by commercial conditions. I have not thought it well to longer hold back the printing of these notes for a paper on this subject, for three reasons:—

1. Mr. W. M. McFarland's article, reprinted from *Cassier's Magazine*, and included in the "Reprints of Lectures and Papers," should be sufficient, unsupported by further words on my part, to convince intelligent engineer-students that the condition named is one with which they must be prompt to comply;

2. I am continually including illustrations of this truth in connection with all my talks on the other business features of engineering practice;

3. It should not be difficult for a student possessed of sufficient intelligence to successfully meet the test of three years of our "weeding-out" process to appreciate that an engineering design or an industrial undertaking must necessarily be along lines which will afford an adequate return to the investor; that, therefore, the description of the engineering project must be such as to appeal to the banker who acts as the intermediary between those responsible for industrial undertakings and the general investing public; and that the honest and capable engineer

must be prepared to discriminate between immediate and final profit.

My experience with three senior classes is in accord with this theory. I have found the students more ready to acknowledge that commercial conditions control and limit engineering practice than they are to undertake the drudgery of preparing themselves to intelligently and efficiently meet this condition by familiarizing themselves with business methods.

Summarizing my instruction on the Business features of Engineering practice I say—use your common-sense as cultivated and developed by your "Stevens" training; rely upon your reasoning powers rather than your memory.

And finally—Be true to yourselves and so be true to your Alma Mater.

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TITLE